PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

MAY 1956

Special Feature on
PLASTICS EXPOSITION

PIPE MADE FROM KRALASTIC RESIN BEING COOLED BY WATER AFTER EXTRUSION

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PUBL CATION

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1956
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RY.

If your manufacturing operations include potting, sealing, impregnating, laminating, bonding or tooling . . .

Easy to use

EPON® RESIN

can give improved mechanical and electrical properties . . . plus faster processing

Because of their excellent mechanical and dielectric properties, Epon resins are important materials in electrical and electronic manufacture. Epon resins combine high strength with low shrinkage on curing and extreme dimensional stability.

For potting, sealing and impregnating, Epon resins permit safe enclosure of delicate components, maintain high insulation resistance under extremes of temperature and humidity, and are resistant to chemicals.

Epon resins laid up with inert fibrous fillers produce laminates that have excellent dielectric properties and can be sheared, punched, drilled and bath soldered.

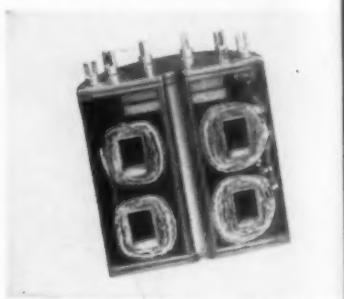
Solvent-free Epon resin adhesives, curing with contact pressure alone at room temperature, form powerful bonds between glass, metal, wood or plastic.

Because of dimensional stability and impact resistance, Epon resins play the key part in making plastic tools such as forming dies, jigs, patterns, templates and fixtures.

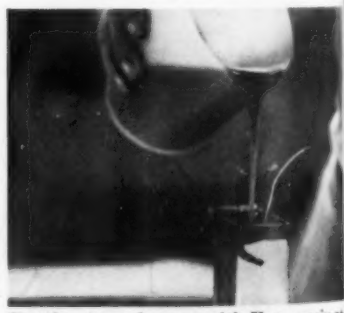
Write for "Epon Resins For Structural Uses." Your letterhead request will bring you a sample for evaluation.

(Epon resins are the epoxy polymers manufactured exclusively by Shell Chemical Corporation.)

Miniature electronic components potted in Epon resin by Freed Transformer Company, Brooklyn, New York.



Section of magnetic amplifier coils embedded in Epon resin by Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.



Potting transformer with Epon resin at PCA Electronics, Inc., Santa Monica, California.

SHELL CHEMICAL CORPORATION

CHEMICAL SALES DIVISION, 380 Madison Avenue, New York 17, New York

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IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited • Montreal • Toronto • Vancouver

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PLASTICS TECHNOLOGY

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MAY, 1956
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Cover: Photo of Uscolite pipe extrusion courtesy of Ft. Wayne, Ind., plant, Mechanical Goods Div., U. S. Rubber Co.

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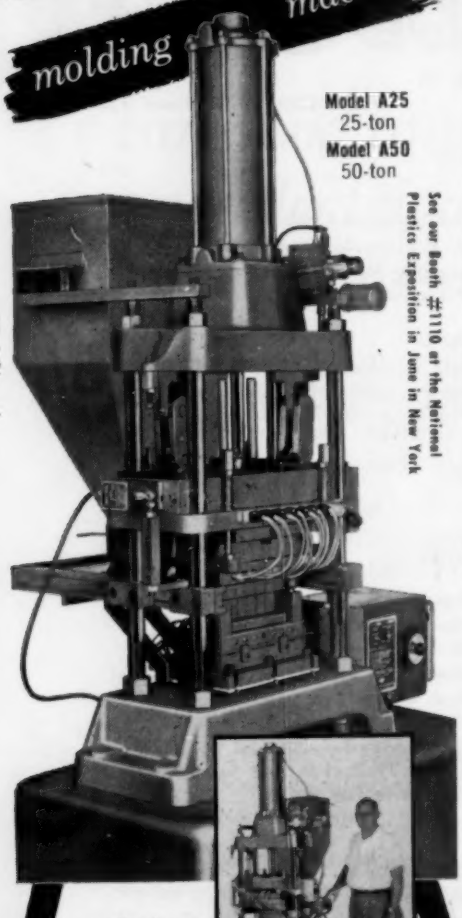
NEW!
AUTOMOLD
FULLY AUTOMATIC
high speed
compression
molding machine

Model A25
25-ton
Model A50
50-ton



See our Booth #1110 at the National Plastics Exposition in June in New York

Needs no operator. Cycles continuously. Just adjust to start—refill with raw material as needed—then remove a constant stream of finished products.

Lowest first and maintenance costs. Free counsel on mold design and production. Write for brochure on 25 and 50 ton models. Some territories still open for representatives. Contact

AUTOMATIC MOLDING MACHINE CO.
3217 Exposition Pl., Los Angeles 18, Calif., Dept. F

Letters to the Editor

Corrections for Isocyanate Article

Dear Sir:

We would like to comment on that portion of the article on isocyanate products in your March issue which referred in passing to our company and the vinyl foam industry.

Certainly, we cannot agree with the implications of the statement that our licensing arrangements in relation to vinyl foam place this product at a disadvantage. At best, this is a highly debatable issue.

The article unfortunately quotes a previous misquotation which has already appeared in print to the effect that we "claim" 85% of the market for "flexible plastic foams." Actually, we claim at least 85% of the market for "flexible vinyl foams" as opposed to vinyl foam made with chemical blowing agents. Also, in listing some of our licensees, no mention is made of the two largest producers of vinyl foam products; Brown Rubber Co. for molded products, and Bolta Products, Division of General Tire & Rubber Co., for sheet stock. Finally, the article implies some mystery regarding the expiration of our patents, but then indicates the date is 1966. Actually, our only issued patent, U. S. #2,666,036, does not expire until early in 1971; such other patents pending, as eventually issued, will expire in later years.

We feel it would be advisable to try to clarify these issues, even though the earlier comments relate to quotations from a previous publication.

Henry E. Allen, Vice Pres.,
Elastomer Chemical Corp.,
Newark, N. J.

(We are happy to print these corrective comments to set the record straight and provide our readers with the most accurate and complete information.—Editor)

• • •

Educating the Public

Dear Sir:

Perhaps I should have written you earlier complimenting you on the overall coverage of your magazine. I personally find interest in all your items and know that others in our organization feel pretty much the same way.

The education of the public, whether it be the lay consumer or the technical industry man, is still of great importance to those of us who manufacture plastics. Misapplications—the use of the wrong plastic or the use of the right plastic in the wrong place—still plague us to some degree. The proper labeling of finished articles with particular respect to what may or may not be expected of them is terribly important.

Othman, the columnist, recently wrote an article on this very subject which was circulated widely through the newspapers of his syndicate. One of the things he said was: "A houseware item which carried a marking 'Will not be harmed if washed in water that is no hotter than the human hand can withstand' seemed to be particularly descriptive and helpful in keeping such articles out of automatic dishwashers."

Any help that you may bring the industry through your editorials and other articles would be much appreciated.

Charles Lichtenberg, Assistant
to the General Manager,
Monsanto Chemical Co., Plastics Division,
Springfield, Mass.

(We agree that the subject of plastics misapplication merits continuing editorial treatment, and plan to do our part in educating the industry to prevent future misapplications and to emphasize the need for proper informative labels on plastics products.—Editor)

• • •

Wants more Attention to Plastics for Building

Dear Sir:

I suggest you consider devoting more space to the wide range of plastics materials being specified in the construction of homes and commercial buildings.

The use of plastics in building is being specified by architects who recognized plastics in their own right as a basic architectural material.

Alexander C. H. Weiss
Russell Reinforced Plastics Corp.,
Southern Division,
Boca Raton, Fla.

(The space given to any subject is in accordance with the interests and desires expressed by our readers; as such, they de-

termine the contents of the magazine. May we hear from our other readers on their interest in "plastics in building?"—Editor)

• • •

Dielectric Heating Unit

Dear Sir:

We are in the market for a small dielectric heating unit for use in laboratory work with vinyl foams. The unit should accommodate samples up to 20 cubic inches in volume, and should be capable of producing temperatures up to 375° F. Any help you can offer in locating equipment of this type will be appreciated.

C. L. Jacocks, Research Chemist, Petrochemical Research Div., Development & Research Dept., Continental Oil Co., Ponca City, Okla.

(A list of suppliers of such dielectric heaters has been sent to Mr. Jacocks. Can our readers offer any assistance?—Editor)

• • •

Copies or Reprints of Articles

Since the inception of the magazine, we have received many requests for reprints or copies of our articles and other editorial items. Most of these requests have been filled; others could not.

Each month, we receive a limited number of unbound pages of PT from the printer. These unbound pages are used to provide tear-sheet copies of all editorial items upon request, as long as stocks allow. All tear-sheet copies are furnished without charge.

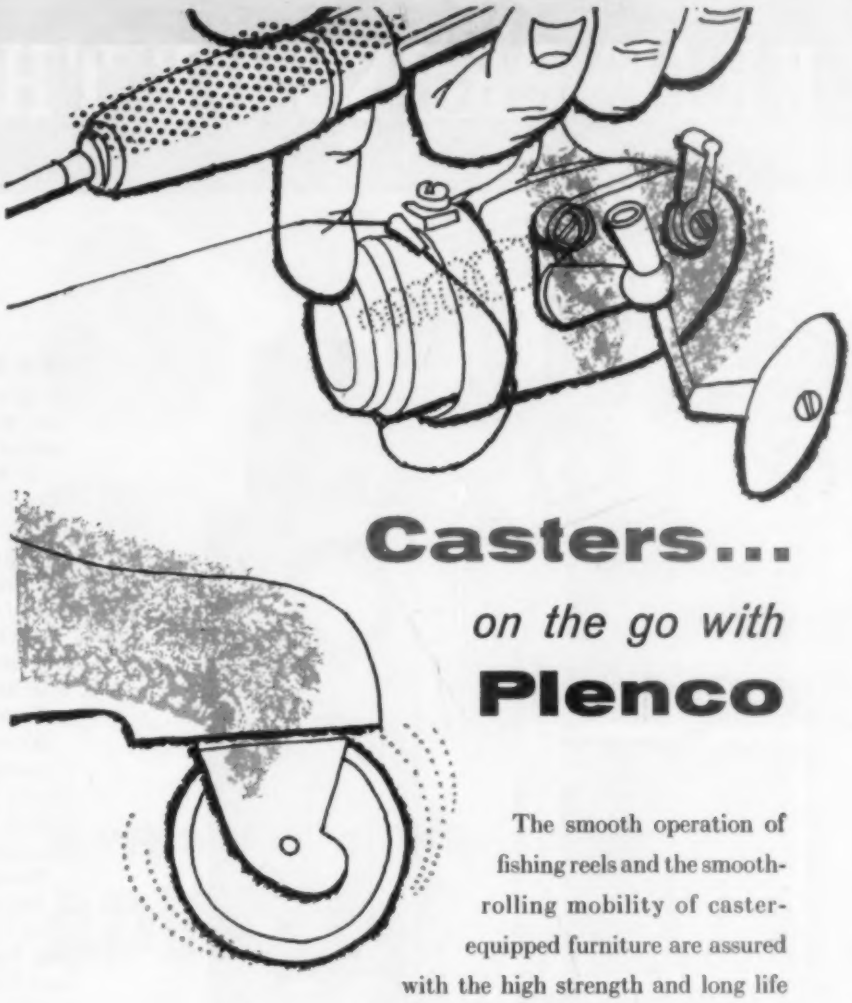
Arrangements have been made for reprints in quantity. Such reprints can be made by the letterpress printing process (the same used for the magazine) in quantities that are multiples of 250, and by the photo-offset process (a somewhat poorer reproduction) in multiples of 100. Reprinting time is approximately two weeks after receipt of the customer's order. Quotations for such reprints are furnished upon request.

—The Editor

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation, and address.

Letters requesting information on technical or engineering problems will be printed to elicit replies by the readers, either directly or through these columns. Upon request the identities of such "problem" letters will not be divulged.

—The Editor



Casters...

on the go with

Plenco

The smooth operation of fishing reels and the smooth-rolling mobility of caster-equipped furniture are assured with the high strength and long life of quality phenolic plastics. These are but two examples of the countless products that make use of Plenco phenolics' extreme resistance to chemicals, temperature changes and abrasion.

Manufacturers and molders rely upon Plenco to provide phenolics that measure up to the most exacting demands. A never-ending program of research, testing and special services is conducted by Plenco to improve production techniques and expand your profits.

We'll welcome the opportunity to show you how much Plenco phenolic molding compounds and resins can improve your product.

See the Plenco exhibit —
7th NATIONAL PLASTICS EXPOSITION
New York Coliseum, June 11-15

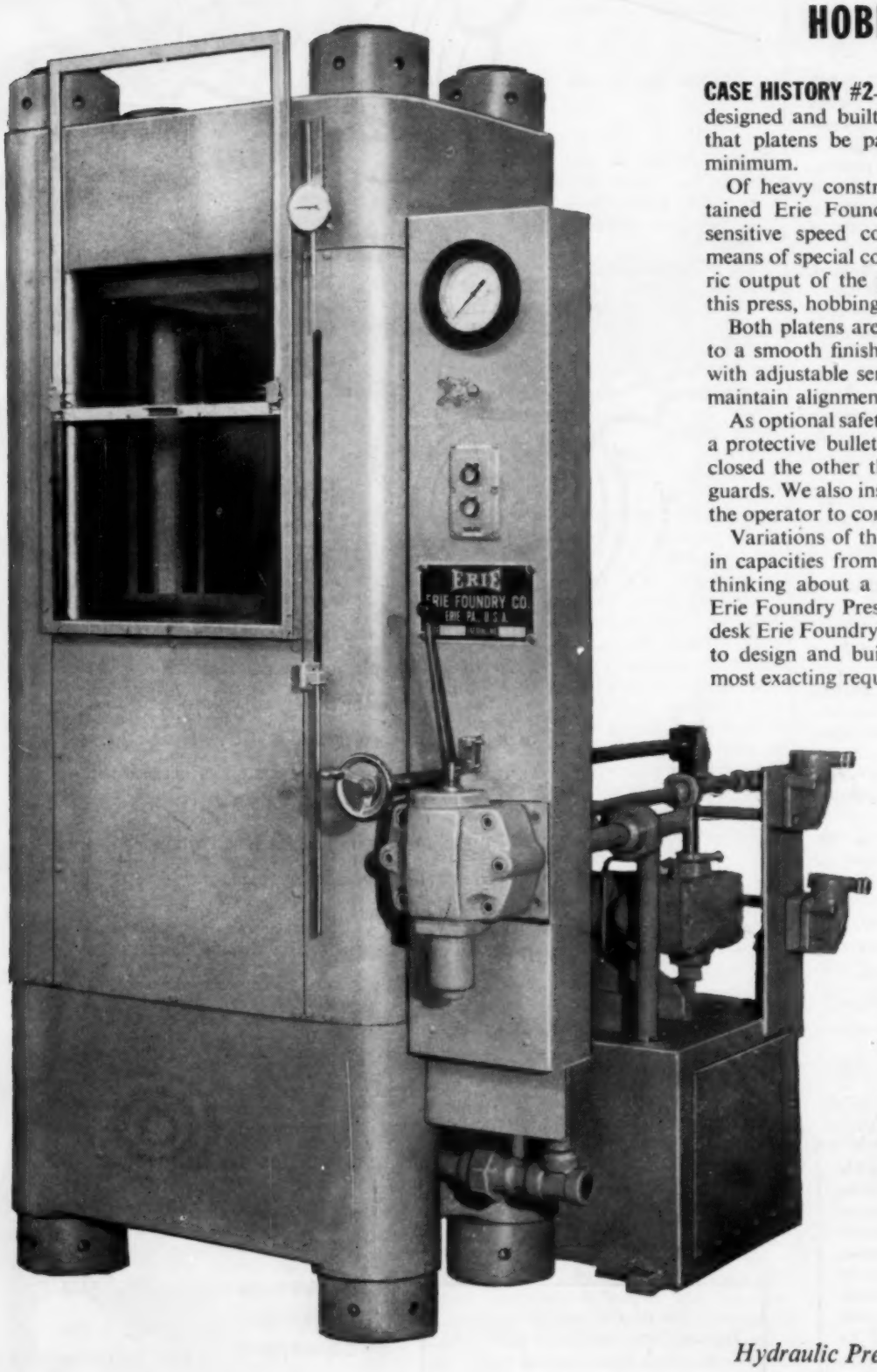
PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

ERIE PRESS OF THE MONTH

HOBBING PRESS



CASE HISTORY #2—This 500 ton Hobbing Press was designed and built for a customer who demanded that platens be parallel and deflection kept to a minimum.

Of heavy construction throughout, the self-contained Erie Foundry Hobbing Press achieves the sensitive speed control essential for hobbing by means of special controls which change the volumetric output of the pump under load (pressure). On this press, hobbing is a smooth, sensitive operation.

Both platens are accurately machined and ground to a smooth finish and the ram platen is equipped with adjustable semi-steel guides on each corner to maintain alignment.

As optional safety equipment, Erie Foundry added a protective bullet-proof glass sliding door and enclosed the other three sides of the press with steel guards. We also installed a depth gauge which allows the operator to control each hob accurately.

Variations of this hobbing press can be furnished in capacities from 200 ton to 3000 ton. If you are thinking about a new hydraulic press, call in the Erie Foundry Press Engineer. He will bring to your desk Erie Foundry Company's experience and ability to design and build a press which will meet your most exacting requirements.

ERIE

SINCE 1895

Hydraulic Press Division

ERIE FOUNDRY CO. ERIE, PA.

"Quote . . . Unquote"

Future Shortage of Scientists

"The big question is who will do the research, the engineering, the commercial development of this expanding (chemical) industry in the years ahead?

"In January 1954, according to a recent study by the National Science Foundation, there were 62,700 scientists and engineers working in the chemical industry, or one out of 12 of total chemical employment. Of these, some 26,000 were engineers and 23,400 were chemists. More than half of the executives in 75 chemical companies have degrees in science or engineering or both, and this trend grows each year.

"Today, we are training only half the number of chemists, engineers, and scientists that will be needed to keep our economy growing at the rate planned and built for. Less than half of our high schools teach either physics or chemistry. The number of people becoming teachers of science has dropped 53% in the last four years. Between 250 and 400 thousand students now enrolled in high school science courses are learning from teachers not trained to teach science. All these factors add up to the estimate that we shall be short 100,000 scientists and engineers within four years."

John R. Hoover, President,
B. F. Goodrich Chemical Co.
Cleveland, Ohio
and
1956 Chairman of the Board,
Manufacturing Chemists' Association, Washington, D.C.

• • •

History of Vulcanized Fiber

"Vulcanized fiber is the grandfather of present-day laminated plastics. For more than 80 years, manufacturers in all industries have found important, cost-saving uses for this versatile cellulose plastic material.

"There are ample reasons for the wide, successful use of vulcanized fiber. It's one of the strongest industrial materials known to man, yet it weighs only half as much as aluminum and one-third as much as steel. Being tough and resilient, it is capable of absorbing considerable impact without damage. Yet it is easy to form, easy to machine, and relatively low in cost. In addition, it has excellent mechanical strength and good electrical insulating properties. This unique combination of properties has made possible the many applications for vulcanized fiber throughout industry."

John Macadam, Application Engineer,
National Vulcanized Fibre Co.
Wilmington, Del.

SPRINGTIME IS
ADVASTAB TIME

Why? Because in Springtime, Mr. Average American plans his lawn and garden, and more important to you, buys his gardening supplies . . . like hose. He knows what he wants, too . . . quality, dependable long life, a fair price, etc.

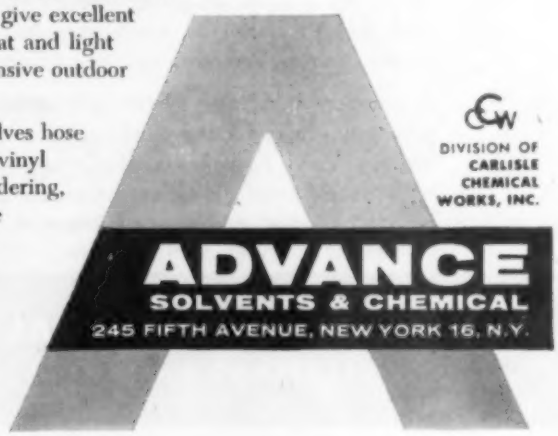
You can give him a quality vinyl garden hose that looks well and will stand up under hard usage by joining the other quality hose manufacturers who use ADVASTAB Vinyl Stabilizers. There's a stabilizer to solve your problem in the Advance line.

ADVASTAB T-52 —the organo-tin stabilizer that is the time-tested standard of the industry for premium hose. ADVASTAB T-52 has had the longest record of satisfactory weather exposure in clear vinyl hose. Not a soap, there is no problem of water absorption.

ADVASTABS C-77, C-79, C-143

—exceptional cadmium compounds developed to meet the demand for low cost stabilizers for clear hose. These stabilizers give excellent clarity, have outstanding heat and light stability and withstand extensive outdoor exposure tests.

Whether your problem involves hose or any of the other forms of vinyl processing—extruding, calendering, rigids or plastisols—there are Advance Stabilizers to help you. Write for samples and complete data. When writing, it would help if you would outline your stabilization problem.



HEAT V LIGHT

HARSHAW VINYL STABILIZERS

for the vinyl plastic and coating industries

Important additives for processing and stabilizing clear and opaque vinyls—

CALENDERED FILMS AND SHEETS • EXTRUSIONS
RIGIDS AND FLEXIBLE
PLASTISOLS • ORGANOSOLS • COATINGS

CADMIUM 2-V-4

Leading heat and light stabilizer for clear or opaque stock, an organic liquid complex containing no disadvantageous soapy component. Unequalled for stabilizing against effects of sunlight or outdoor aging.

BARIUM-CADMIUM 128-V-5

Leading combination of coprecipitated laurates for outstanding performance, where lubricating advantages are required. Generally 30% more effective than common barium-cadmium laurates.

Best effects are attained for particular requirements by combining 2-V-4 or 128-V-5 in a stabilizing system with one or more of the following three stabilizers.

BARIUM 1-V-4

Compatible barium compound, minimum effect on viscosity. Permits processing at higher temperatures.

ORGANIC 8-V-1

Chelating agent, more than two times as effective as common organic phosphites. Inactivates harmful by-products to boost stability. Contributes to top clarity.

ORGANIC 7-V-2

Epoxy assistant, highly effective HCl scrubbing agent, undiluted. Will extend stability for longer processing periods.

CADMIUM 28-V-2

For rigids, opaque to translucent. Stabilizes unplasticized resin efficiently and economically, with minimum effect on physical properties of product.

Stabilizing Systems developed for Harshaw Customers, for special processing and finished product properties, may contain one of the following stabilizers.

ZINC 9-V-1: Organic liquid complex containing no disadvantageous soapy component used in selected formulations.
CADMIUM 2-V-7: For modified solutions and organosols.
CADMIUM 24-V-1: Organic liquid complex for highest attainable clarity, used principally with dispersion resins.
CADMIUM 2-V-400: Modified 2-V-4.
CADMIUM 2-V-8: Selected laurate, used principally with low fusing resins.
BA-CD 12-V-5: Coprecipitated laurate.
CADMIUM 22-V-1: For rigid, clear and opaque stocks.
ORGANIC 7-V-1: Epoxy assistant.
ORGANIC 7-V-4: Epoxy assistant, for rigids.
BARIUM 1-V-3: Dispersible stearate, to contribute lubricity with barium effects.
BARIUM 1-V-6: For asbestos filled tile.
BARIUM 1-V-7: Liquid, for modified plastisols and organosols.
CALCIUM 5-V-1: Dispersible stearate, to contribute with calcium effects.
CALCIUM 5-V-22: Dispersible, low melting stearate to reduce internal friction.
ORGANIC 8-V-100: Modified 8-V-1.

Write for a Vinyl Stabilizer Check List that you may use to detail as much as possible your particular requirements.

A practical stabilizing system will be suggested promptly, based on our experience with the various Vinyl Polymers and Copolymers and with the different Plasticizers, for your processing and product end-use requirements.

THE HARSHAW CHEMICAL CO.
CLEVELAND 6, OHIO

NEWS in BRIEF

Plastics exposition preview in this issue, see pages 324-5-6-7-8-9, has floor plans of exhibit areas; alphabetical and classified lists of exhibitors and their displays; and full information on the Exposition in June 11-15.

Styrene wall tile market for residential use in 1960 will be about 200-million square feet, according to a recent Dun & Bradstreet survey. This prediction, a 50% increase over 1954 sales, will require continuing improvements in tile design and workmanship, and more effective marketing.

Two concurrent design contests for applications of thermoplastic rods and tubes have been announced by Cadillac Plastic & Chemical Co. The first, an open contest, is restricted to product designs either already in production or in tooling by December 1st, while the second contest is open only to students. Entries can cover any usage of cast or extruded rod in any thermoplastic material, and the designs remain the property of the submitter. Criteria in judging entries will be aptness and interest of the application, ingenuity in solving problems, and an understanding of the functional possibilities of the material involved.

Structural resin adhesives have replaced many conventional fastening methods in the production of components for modern aircraft, says C. W. Brown, Narmco v-p and general manager (see guest editorial, pages 312-3). Structural adhesive bonding has many design potentials in the aircraft industry, and is finding increasing usage because of its structural efficiency.

Company developments announced this month included the formation of a new firm, Hastings Plastics, to make and distribute compounded resins. Resin Industries, Santa Barbara, Calif., has been purchased by Borden, which will operate it as a wholly-owned subsidiary. Monsanto formed a new division to administer its interests in Shawinigan Resins Chemstrand, Mobay, and other affiliates. Reichhold Chemicals and Catalin will merge into a new firm to be known as Reichhold-Catalin Industries.

Company expansions in plastics continue in full flood. Ace Plastic added 50% more plant area to its extrusion department in Jamaica, N. Y. An annual cellophane production increase of 50-million pounds is planned by American Viscose at its Marcus Hook, Pa., plant. Air Reduction Chemical's new vinyl acetate monomer plant at Calvert City, Ky., is in operation. A new plant for polyethylene films and tubing is being built by Canadian Resins & Chemicals at Ste. Therese, Que. Du Pont opened the new product development and technical service lab for its elastomers division. Goodrich Chemical will expand output of vinyl resins and compounds at Avon Lake, O. Polyester resin output at Niagara Falls, N. Y., will be doubled by Hooker. A new laminating lab is being installed by Monsanto at Springfield, Mass. A new branch plant for cellulose castings and plastic packaging materials will be built by Tee-Pak at Danville, Ill. New polyethylene production facilities are being constructed by Texas Eastman at Longview, Tex.

New Materials worthy of mention (see pages 341-2): polysulfide potting compound; non-bleeding azo pigment; series of glass-reinforced polyester laminates; modified epoxy resin for electrical applications; and micro-fiber glass papers for use in reinforced plastics.

New Equipment of special interest (see pages 343-4): portable electric ovens; high-temperature pressure gages; rotary laminating press; and semi-automatic marking machines for plastics.

New Products to be noted (see pages 346-7): styrene model boats; vinyl pothead covers for lead-in wire terminal connections; polyethylene caps and plugs for protecting machined threads; metallized nylon hardware for the home; rigid vinyl conductor systems for cranes and monorails; nylon wear strips for conveyors; glass-polyester fire-retardant lighting panels; wood-grain-finished sheets of rubber-modified styrene; and chip-resistant spray coating for molded phenolic parts.

A TECHNICAL REPORT from Du Pont

• *Properties and application data on ALATHON® polyethylene resin*

Coatings, film, tubings, closures and all types of molded products have extra advantages when made of "Alathon" polyethylene resin. "Alathon" is strong, lightweight, corrosion-resistant; is free from odor, taste and toxicity.

Important and expanding uses for "Alathon" include housewares, toys and flexible, long-service pipe for farms and industry. Outstanding dielectric properties and abrasion resistance of "Alathon" make it a superior insulating and jacketing material for electrical applications.

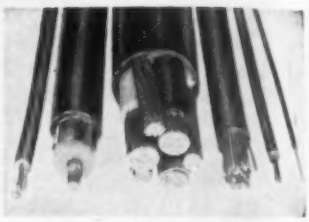
"Alathon" can be readily molded and extruded. Practically any size and shape container can be fabricated. Articles can be made in a wide variety of attractive colors.

Property data on this versatile engineering material are shown below. For further information on "Alathon" write to: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 495 Du Pont Building, Wilmington 98, Delaware. In Canada: Du Pont Company of Canada Limited, P. O. Box 660, Montreal, Quebec.

Lightweight, flexible pipe of "Alathon" is easy to install, economical to maintain. It resists corrosion, can be installed above the frost line.

Housewares of "Alathon" can be fabricated in almost any size and shape. They're easy to keep clean, won't shatter, crack or dent.

Jacketing and insulation of "Alathon" for wire and cable have excellent dielectric properties, superior abrasion and heat resistance, and excellent weatherability.



MECHANICAL PROPERTIES		Units	Test method	
Tensile strength	−67°F.	lb./sq.in.	D412-51T	2,600
	73°F.	lb./sq.in.	D412-51T	1,750
	158°F.	lb./sq.in.	D412-51T	850
	−70°F.	lb./sq.in.	D638-52T	4,750
	73°F.	lb./sq.in.	D628-52T	1,900
	158°F.	lb./sq.in.	D638-52T	950
Yield point	−67°F.	lb./sq.in.	D412-51T	4,800
	73°F.	lb./sq.in.	D412-51T	1,700
	158°F.	lb./sq.in.	D412-51T	850
Elongation	−67°F.	%	D412-51T	60
	73°F.	%	D412-51T	600
	158°F.	%	D412-51T	600
Modulus of elasticity	73°F.	lb./sq.in.	D638-52T	35,000
Stiffness	−67°F.	lb./sq.in.	D747-50	230,000
	73°F.	lb./sq.in.	D747-50	27,000
	158°F.	lb./sq.in.	D747-50	8,000
Shear strength	73°F.	lb./sq.in.	D732-46	2,750
Impact strength, Izod	−40°F.	ft.lb./in.	D256-47T	0.8
	73°F.	ft.lb./in.	D256-47T	did not break
Hardness, Shore			D676-49T	C81,D48

THERMAL PROPERTIES			
Thermal conductivity	B.T.U./hr./sq.ft./°F./in.	Cenco-Fitch	1.75
Heat-distortion temperature, 66 lb./sq.in.	°F.	D648-45T	121
Softening point, Vicat	°F.		201
Brittleness temperature	°F.	D746-51T	<−105

ELECTRICAL PROPERTIES	Units	Test method	
Dielectric constant 60 cycles to 100 megacycles,		D150-47T	2.3
Power factor, 60 cycles to 100 megacycles		D150-47T	0.0005

MISCELLANEOUS PROPERTIES			
Flammability	in./min.	D635-44	0.94
Specific gravity		D792-50	0.92
Water absorption	%	D570-42	0.014
Melt index		D1238-52T	2.1
Index of refraction	n_D	D542-50	1.51
Mold shrinkage	in./in.		0.02-0.05
Compression ratio		D392-38	2.1–3.6

NOTE: Data shown are average values of molded "Alathon" 10. These values should not be used for specifications.

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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

PLASTICS TECHNOLOGY

MAY, 1956

EDITORIAL: Sharing Industry Responsibilities—II

Continuing the discussion begun in last month's editorial, it was pointed out that the plastics industry consists of two main groups —the materials suppliers and the plastics processors. Each group has related stakes in the service success or failure of finished plastic products, and each has certain responsibilities to themselves, to each other, and to the users of plastic items.

Unfortunately, each group often ignores its responsibilities. As noted last month, the suppliers often fail to provide the processors with honest, comprehensive information on the materials and their processing conditions.

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The processors have the responsibility of choosing the right material for the specific job at hand, and properly processing the material so as not to impair its desirable properties. In practice, however, the processors have been quite successful in ignoring these responsibilities.

In the consumer products field, plastics are still trying to recover from the damaging reputation they have gained as cheap, inferior items that quickly break or fail in service. While the lack of adequate consumer education on plastics has been a contributing factor, plastics processors in the consumer products field have played a major role in fostering the public's poor opinion of plastics.

Too many processors were obsessed with the idea of making a quick profit on their goods, regardless of their utility in service. To some extent, this principle still persists among processors of consumer goods.

The system of operation for many processors of consumer plastic products is to find a household item that can be made of plastic; make the item at minimum cost (and at minimum utility); and rush the item to market so that it may be sold in volume before the design can be copied and the item made even more cheaply.

With this system of business operation, is it any wonder that plastics are stigmatized by the consumer as cheap materials that fail to provide the service expected of the older materials they replaced?

•

Yet coincident with this poor opinion of plastics by the public is the steady gain in popularity of plastic parts for industrial applications. This phase of the problem will be discussed next month.

Arthur M. Merrill

Editor

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DRAPEX 3.2

LOW TEMPERATURE EPOXY PLASTICIZER

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The chart on the right shows the results of tests conducted to compare the soapy water extraction of Drapex 3.2 with other plasticizers. Equal size samples of the various materials were laundered in a small washing machine for ½ hour in a ½% Ivory Soap solution, at a water temperature of 150° F. The samples were spun dry, rinsed in fresh water for 10 minutes at 150° F. They were then dried in an air circulating oven at 212° F. Assuming that all losses are plasticizer losses, the chart reveals the important advantage of Drapex 3.2.

In addition, the low temperature flexibility of Drapex 3.2 is superior to DOA. Its lower specific gravity is combined with a low volatility.

The epoxy content of Drapex 3.2 provides excellent stability, high heat resistance, and good weathering characteristics. All of these advantages help you make better, longer lasting vinyls at lowest cost. Make your own test and see. Write today for Technical Bulletin 4 and a generous working sample.

SOAPY WATER EXTRACTIONS (½% Ivory Soap Solution @ 150° F.)

COMPOUNDS TESTED					
Resin	100.0	100.0	100.0	100.0	100.0
Dioctyl Phthalate	45.0	30.0	30.0	30.0	30.0
Dioctyl Sebacate	—	15.0	—	—	—
Dioctyl Adipate	—	—	15.0	—	—
Butyl Epoxy Stearate	—	—	—	15.0	—
▶ DRAPEX 3.2	—	—	—	—	15.0
Per Cent of Total Plasticizer Lost					
5 Laundering Cycles	3.9%	2.3%	6.9%	12.7%	2.6%
6 Laundering Cycles	4.9%	3.1%	8.7%	14.6%	3.5%
7 Laundering Cycles	6.0%	4.2%	10.3%	16.5%	4.4%
8 Laundering Cycles	6.6%	4.7%	11.4%	17.9%	5.1%
9 Laundering Cycles	8.5%	5.7%	13.8%	19.8%	6.1%
10 Laundering Cycles	9.3%	6.5%	14.7%	20.4%	**6.8%**

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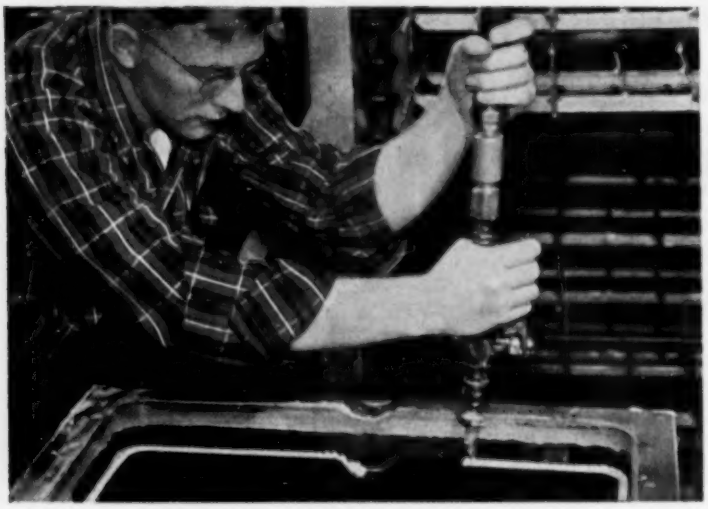

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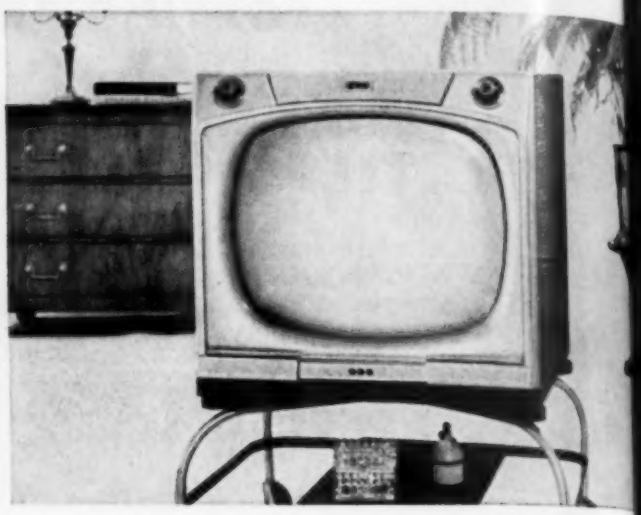
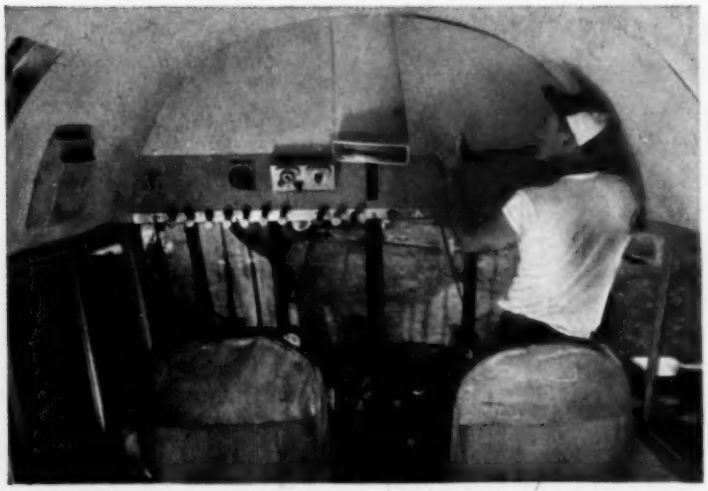


What do Flowable Gaskets, Flying Wa



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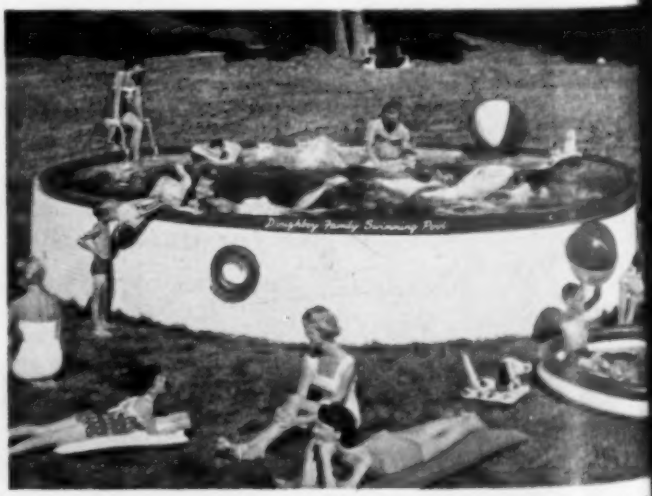

KING-SIZED KIDDIE POOL lets whole family swim in backyard. It's made of heavy-duty **PLIOVIC** sheeting for high strength and resistance to water, sunlight, hard wear and age.

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The Plastics Department is new, yet not new. It results from a recent reorganization designed to give customers of the Chemical Division the ultimate in service and quality. It combines experience with the verve and vitality of a new organization well equipped to make its mark in a highly competitive market.

Why not learn how the new Plastics Department can give your present or potential product something in common with those shown here—success! You can, simply by writing and asking for help to: Goodyear, Chemical Division, Dept. Q-9441, Akron 16, Ohio.

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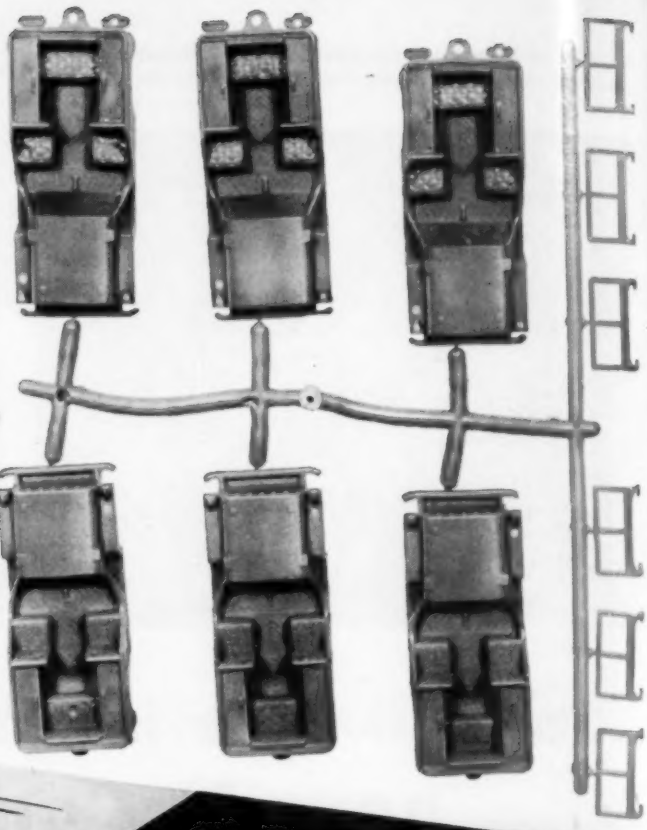

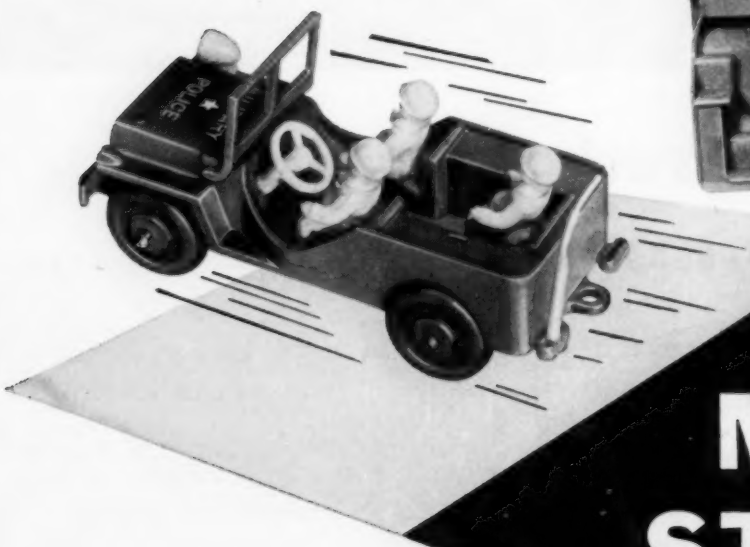

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Dr. Paul M. Elliott was born in Beverly, Mass., and received a B.S. in Chemical Engineering from the University of Maine, and a Ph.D. from Cornell University. He was employed by Du Pont as a research chemist during 1936. He joined U. S. Rubber in 1937 as a research chemist in the company's general laboratories, and transferred to Naugatuck in 1939. After working in plastics development for Naugatuck from 1942-1954, he assumed his present position in 1954. Dr. Elliott is a member of ACS, SPI, SPE, and several honor societies. He currently resides in Naugatuck, Conn., with his wife and two daughters.

Fabrication and Properties of Kralastic Pipe*

Fabrication methods for Kralastic pipe are discussed and detailed information given on its properties, with emphasis on burst strength, tensile, and aging.

PAUL M. ELLIOTT, *Manager of Kralastic Development and Technical Service,*

Naugatuck Chemical Division of United States Rubber Co., Naugatuck, Conn.

Plastic pipe does not currently consume a large portion of the plastic used in this country, and the total mileage consumption of plastic pipe is still very small when compared to that of metal pipe. Nevertheless, plastic pipe has become an important commercial item and its use is growing very rapidly. The inherent advantages of plastic (light weight, chemical resistance, absence of electrolytic effects, etc.) assure plastic a market which will continue to grow as we develop more knowledge of the possibilities and limitations of the various plastic materials.

There are four major materials currently used for plastic pipe—polyethylene, acrylonitrile copolymer-blend resins, cellulose acetate butyrate, and polyvinyl chloride. This paper is concerned with our acrylonitrile copolymer blend material, Kralastic; what it is, how it is fabricated, and what can be expected of pipe made from it.

Nature of Kralastic

About 10 years ago, in the course of studies on the properties of various copolymers, several different laboratories found that those prepared from mixtures of

* Based on a paper presented at the twelfth annual National Technical Conference, Society of Plastics Engineers, Inc., Cleveland, O., Jan. 19, 1956.

acrylonitrile and styrene had a number of advantages over the then-available plastic polymers. In comparison with the widely used polystyrene compounds, for example, the acrylonitrile-styrene copolymers showed increased toughness, better chemical and solvent resistance, considerably higher heat distortion temperature, and improved weathering resistance.

Subsequent study by U. S. Rubber laboratories showed that combining the acrylonitrile copolymer resins with selected acrylonitrile-butadiene rubbers, resulted in a series of alloys or gum-plastics exhibiting a unique combination of hardness, toughness, and chemical resistance. These acrylonitrile copolymer blend plastics in the form of extrusion and molding compounds are known as Kralastics.

General Properties

All of the Kralastics have low specific gravity. While hard and stiff under normal use conditions, they still can be formed easily by conventional molding or extrusion operations. Toughness varies with different members of the series; the toughest being the B-type molding and extrusion compounds. Typical properties for these materials are shown in Table 1.

Table 1. Physical Properties of Kralastics B-1 and B-3

Specific gravity (Natural)	1.05
Hardness, Rockwell "R"	93-96
Izod impact @ 73° F., ft.-lbs./in. of notch	5-10
Charpy impact @ 73° F., ft.-lbs./in.	35-55
Flexural strength, psi	8,500-9,000
Tensile strength, psi	4,000-5,000
Modulus (flexural), x 10^3 psi	250-300
Heat distortion temperature, °F.	180-187
Water absorption, 24 hours, % by weight	0.3
Refractive index	Opaque
Coefficient of thermal expansion, x 10^{-5} °F.	5.3-6.0
Thermal conductivity, B.T.U./hr./sq. ft./°F./in.	1.0
Dielectric strength, volts/mil	300+
Volume resistivity, ohms/c.c.	1.8×10^{13}
Dielectric constant, 60 cycles/sec.	4.7
Dissipation factor, 60 cycles/sec.	0.02

It is only natural that such a material should be used in pipe. The combination of their hardness, stiffness, and toughness properties, the inherent chemical and solvent resistance of the acrylonitrile copolymer system, the ease with which the materials could be fabricated, and the fact that separate pieces could be joined readily by mechanical means (e.g., threading) or by cementing, led to early application of Kralastic in the field of corrosion-resistant piping.

Pipe Fabrication

The extrusion of Kralastic pipe closely follows the general practice of plastics extrusion, including the fact that practically every extrusion set-up is unique in one or more features. Extrusion is an art, and each extruder soon develops techniques and equipment details that are his alone.

The general equipment and operating features for extrusion are as follows:

MACHINE. Standard; straight head; 2.5:1 to 4:1 compression screw; polished pin and die with lands equal to O.D. or better; screens 40- or 60-mesh; multiple sizing ring; air rings, cascade, or water-bath cooling; powerful take-away.

OPERATION. Predried and preheated material; material at die, 400-430° F.; die, 400-450° F.; drawdown, 10-15%.

Many modifications are encountered in practice, of course, Some offset-head extruders are being used. Some plants use the nylon metering or torpedo-type mixing screws, and practice in the use of screws varies considerably. In die design, we find a large proportion of the variations which differentiate the various set-ups.

Pre-drying is generally considered essential, and preheating is desirable. Care must be taken that this preheating is uniform if best results are to be expected. Machine temperatures will vary quite widely, but stock temperature at the die is a much more constant figure. Careful control of machine conditions throughout is indicated, since the quality of the finished pipe is largely determined by the extrusion conditions.

Every extruder should set up and maintain adequate control tests to assure the uniformity of toughness, size, strength, and other qualities of his product. The importance of such process control has not been sufficiently emphasized, with resultant detriment to the pipe extrusion industry.

Fittings for cement assembly of pipe, as in SWP sizes, may be made by extrusion; i.e., they may be fabricated from short sections of pipe of the needed diameter and wall thickness. For everything except SWP couplings, however, injection molding is the preferred method of fabrication. Since Kralastic is readily injection molded, this has presented few problems.

General conditions for injection molding are as follows:

MACHINE. Standard; molds with large runners and gates.

OPERATION. stock temperatures, 350-450° F.; mold temperature, 160° F.; injection pressure, quite high.

Of course, these conditions are subject to wide variations to suit the individual machine and mold. Impact, surface appearance, and flexural strength are best at low stock temperatures, but weld strength and heat resistance are better with higher stock temperatures. It is important, therefore, to select molding conditions which give the optimum balance of properties. Here,again, it must be emphasized that adequate process control testing is highly recommended to insure proper product quality.

Pipe Properties

Short-Term Burst

One property of pipe which is generally reported and can be quite easily obtained is a test for a simple short-time burst pressure. The significance of this figure is very much open to question currently, as will be brought out later, but we still believe that it probably constitutes

a relatively simple test which may be useful for plant control.

To introduce some order in burst test results and to permit correlation of test results on pipes of different wall thicknesses and diameters, it is necessary to resort to the use of formulas which convert burst pressure to stress in the pipe wall. Several such formulas are currently in use but, as shown in Table 2, the results obtained are reasonably constant. If any one formula is used throughout, results should be comparable unless the wall thickness: diameter ratio varies considerably.

Table 2. Fiber Stress Calculated by Various Formulas for Pipe 1.740-in. O.D., 0.110-in. Wall Thickness, and 700 psi. Burst Strength

Formula	Fiber Stress
Lamé $S = P\dfrac{D_o^2 + D_i^2}{D_o^2 - D_i^2}$	5,190
Barlow $S = \dfrac{P \cdot D_o}{2t}$	5,540
Modified Barlow #1 $S = \dfrac{P \cdot D_o}{2t} = 0.4\ P$	5,260
Modified Barlow #2 $S = \dfrac{P \cdot D_m}{2t}$	5,190

D_o = Outside diameter; D_i = Inside diameter; D_m = Mean diameter; S = Fiber stress; P = Burst pressure; t = Wall thickness

Short-term burst test taken over a range of temperatures indicate the effect of an increase in temperature on reducing the tensile strength of the pipe material. Figure 1 shows graphically the relationship of fiber stress at burst, as calculated by the Lamé formula, to the test temperature.

In general, the result obtained in a strength test will vary with the rate of testing. Burst tests on plastic pipe are no different from other strength tests in this respect. Figure 2 shows the effect of testing rate on the burst strength of Kralastic pipe.

Long-Term Effective Tensile

As an extension of the fact that as the time to rupture increases the stress to cause rupture decreases, we arrive at the concept that pipe will not support for long periods of time anywhere near the pressure required to burst it in a short time. This holds true whether the pipe is of plastic, metal, or other material.

Since pipe usually fails by the material rupturing in tensile, a short-term burst test is a quick tensile test. Indeed, stresses at burst correspond closely to stresses at rupture in standard tensile tests. We might expect, therefore, that stresses at burst in long-term burst tests would correspond to creep tensile figures for the pipe material being used. Figure 3 shows that such a relation may exist. The correlation between the tensile creep tests and the long-term pipe burst tests seems reasonable.

There are many factors that may influence the length of time a pipe will withstand a given pressure without bursting. These include temperature, whether pressure is static or varying, the occurrence of flaws in or injuries to the pipe, the nature of the material from which the pipe is made, and the heat history of the material (hard copper pipe has a much higher effective tensile than soft copper pipe). Obviously, all of these factors cannot be isolated and studied at the same time.

As a start to determining the needed answer, we secured three commercial samples of Kralastic pipe from three different manufacturers. Two samples were 1½ inch IPS-40 in size, while the third was 1½ inch SWP size. These three pipe specimens were submitted to long-term stress tests at 73 and 90° F., and the test results

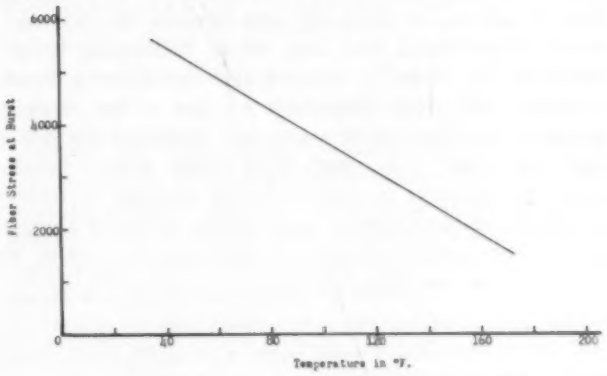


Fig. 1. Effect of test temperature on fiber stress at burst of Kralastic pipe.

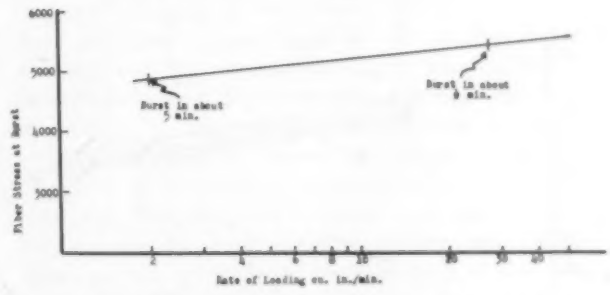


Fig. 2. Effect of loading rate on fiber stress at burst of Kralastic pipe (1½-in. IPS-40) at 73° F.

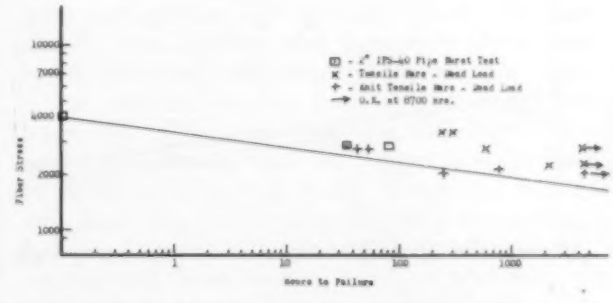


Fig. 3. Relation of time to rupture of Kralastic pipe on fiber stress at burst.

are shown in Figure 4. In these charts, the band for each test temperature indicates the variability experienced in the individual tests.

Figure 5 shows the average data for all three tests plotted on one chart. The dotted line is the result obtained in the earlier tests shown in Figure 3.

At present, we have no way of knowing how safely we can extrapolate these figures beyond the still moderate length of test we now have. All these tests were run on 1½- or 2-inch pipe, and we do not know how well we can extrapolate to lower or larger pipe sizes. Much work is now in progress to answer these questions. Figure 6 shows an extrapolation for longer periods, but we have no proof of its significance.

An interesting observation made in the course of long-term testing of plastic pipe is that the nature of the break may change and the elongation at break definitely does change as the applied stress is decreased. This same phenomenon has been reported also for creep tests on metals. At relatively high stresses, the materials creep considerably and may show ballooning before breaking. As stress is reduced and the time to break increases, the creep diminishes so that at low stresses giving failure only after prolonged exposures there has been, in some cases, very little creep before breaks occurred. Because of this, it is not possible to follow progress toward failure by some measurement of elongation. There seems no way to estimate how close to failure a test pipe may be.

Aging Characteristics

Although the Kralastics are organic materials which might be expected to be subject to aging effects, the control of reaction conditions during synthesis of the resin and the incorporation of selected antioxidants in the final formulations has built into the compounds considerable resistance to the usual causes of deterioration. Shelf-aged samples show no variations in strength, modulus, hardness, notched or unnotched impact or heat distortion temperature during two years of aging. A multitude of extruded, molded, and formed parts have been giving satisfactory service for periods up to five years or more.

In the more severe tests, such as Weather-o-meter or Florida exposure tests, the story has been much the same. Tensile, hardness, flexural strength and modulus, and notched Izod impact are unaffected by exposure in the Weather-o-meter for 3,000 hours or in Florida for 12 months. Only in elongation and the related unnotched impact test have changes been noted. After 100-300 hours in the Weather-o-meter or about one month in Florida, the elongation of natural or light-colored test pieces in tensile tests drops off to about 50% of the original elongation, and then holds essentially constant during further aging up to the periods mentioned above.

This effect is reffected in unnotched Charpy test; thus, if bars with reduced elongation are impacted so that the exposed surface is in tension, the Charpy impact drops off to the value obtained in a notched test. If the same bars are impact tested with the exposed surface in compression, no change in the impact value is noted. As with most other organic materials, the incorporation of carbon black in the compounds confers improved resistance to light exposure tests; thus, bars of B-3601 Black Kralastic have shown no change in unnotched Charpy impact during 15 months exposure in Florida.

Aging tests of various types have been run on Kralastic pipe with burst pressure being used as the

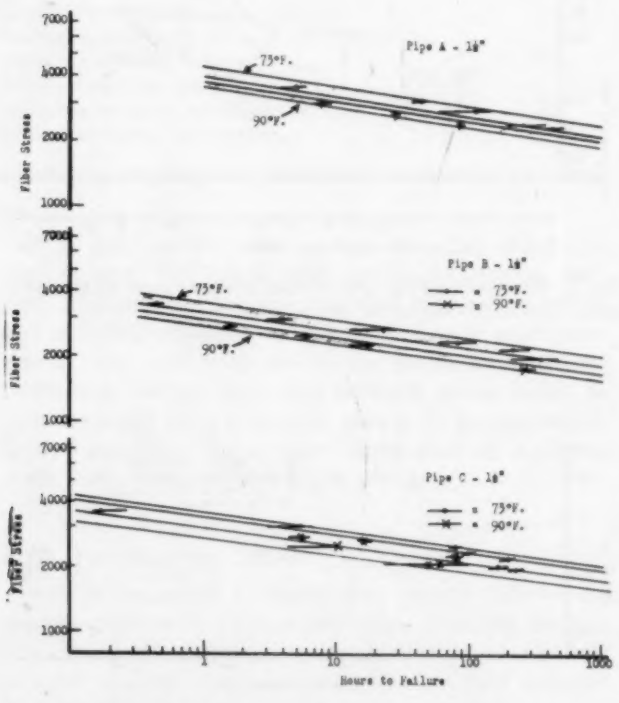


Fig. 4. Effect of fiber stress on time to fail for three types of 1½-inch Kralastic pipe.

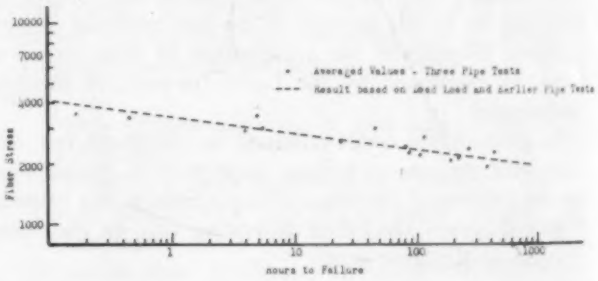


Fig. 5. Fiber stress vs. time to fail at 73° F. (average results).

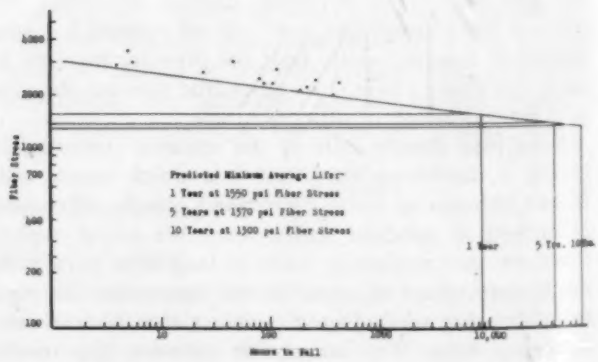

Predicted Minimum Average Life:
1 Year at 1550 psi Fiber Stress
5 Years at 1570 psi Fiber Stress
10 Years at 1300 psi Fiber Stress
Fiber Stress

Fig. 6. Extrapolation of data on fiber stress vs. time to fail for 1½-in. Kralastic pipe at 73° F.

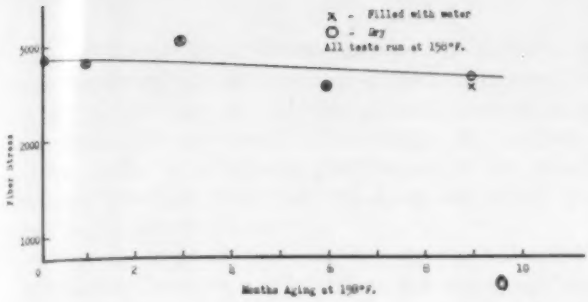


Fig. 7. Fiber stress at burst of Kralastic pipe upon aging at 158° F.

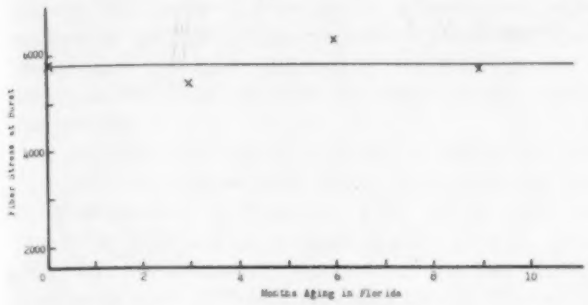


Fig. 8. Fiber stress at burst of Kralastic pipe upon Florida aging (tested at 73° F.).

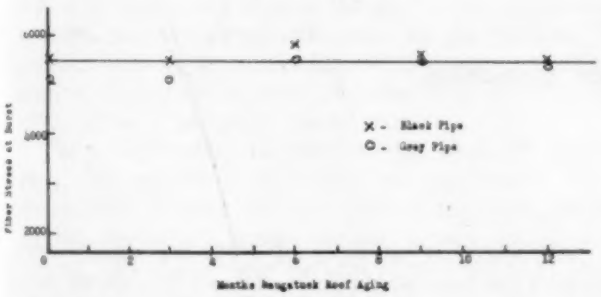


Fig. 9. Fiber stress at burst of Kralastic pipe upon roof aging at Naugatuck, Conn. (tested at 73° F.).

criterion of pipe quality. The results of these tests show little if any change during the course of exposure. Figure 7 shows aging at 158° F. of pipe filled with water and of dry pipe. The burst tests in this case were run at 158° F. Figure 8 shows the effects of nine months' outdoor exposure in Florida, and Figure 9 shows the effects of up to one-year of roof aging at Naugatuck, Conn.

These results are confirmed by actual installations. Although most plastic pipe is either underground or indoors, some installations have been made outdoors where the pipe is exposed to the sun and no failures reported due to aging for periods now approaching six years.

—THE END

Flexible hose connect extrusion nozzles to adhesive reservoir on a Compo dual-head sole cementer.

Resin Lining Extends Cementer Hose Life

While conventional flexible hose used for handling pyroxylin and other types of adhesives lasted about a year in service, specially engineered hose assemblies which utilize a fluorocarbon resin liner instead of the rubber materials previously used are said to be virtually as good as new after three years of use.

The hose assemblies are used on sole and bottom cementers made by Compo Shoe Machinery Corp., Boston, Mass. These cementers are extruding-type units which apply an even coat of shoe adhesive to the margins of soles and bottoms during shoe manufacture. For both classes of machines, a flexible hose must be provided to transmit adhesive from the storage pot to the nozzle. The machines also come in twin-head units which have duplicate adhesive systems for running two types of adhesives, each system having its own flexible hose. Solvent-activating, heat-activating, pressure-sensitive, and other types of adhesives are used in these machines.

The hose used to convey the adhesives was made originally of conventional synthetic rubber material, and maximum hose life was no more than one year before the hose was damaged and fittings came loose. Since the adhesive may be under pressures as high as 150 psi., the hose must be replaced at the first sign of weakening.

After studying the problem, Compo engineers selected Resistoflex R-3800, a specially designed hose assembly manufactured by Resistoflex Corp., Belleville, N. J. The first machines equipped with the new hose assembly were shipped three years ago, and reports from the field state that the new hose after three years' use is virtually unaffected by the adhesives and the constant handling.

The fluorocarbon resin material used in the R-3800 assembly is of special manufacture, and reported to have practically unlimited shelf life and operating life, and to be unaffected by a wide variety of chemicals and industrial fluids. The hose is jacketed with stainless steel wire braid, and has three-piece stainless steel fittings that are swaged directly to the steel sheath to provide a permanent leakproof connection.

—THE END

HENRY E. ALLEN, *Vice President and Sales Manager,*
Elastomer Chemical Corp., Newark, N. J.

Vinyl Foam*

A detailed discussion of basic growth factors for the vinyl foam industry; and specific foam applications, with emphasis on cushioning.

The vinyl foam industry today is the fastest growing field of applications for vinyl resins, and one of the fastest growing segments of the entire plastics industry.

Growth Factors

Three basic factors make possible this remarkable and spectacular growth situation: (1) the enormous productive capacity and wide availability, at moderate cost, of polyvinyl chloride and its plasticizers; (2) the use and development of the plastisol technique; and (3) the development of adequate continuous processing equipment and manufacturing techniques.

Productive Capacity

The productive capacity for polyvinyl chloride and its copolymers in 1955 was in excess of 600,000,000 pounds, and continuing expansion is expected to bring 1956 capacity to about 725,000,000 pounds. This, despite the fact that capacity has substantially exceeded consumption during much of the last five years. Expansion in the face of excess capacity is simply a reflection of the profit margins which make feasible plant operations below capacity rates.

Although not all types of PVC are equally satisfactory for foaming purposes, enough is available today to support a vinyl foam industry of well over 75,000,000 pounds per year. The vinyl price reductions of last year will prove to have been only a start. As vinyl usage continues to grow, permitting more efficient use of existing plants, further price reductions can be logically expected, barring inflationary pressures.

It is this enormous productive capacity, plus the promise of a stable or downward trend in price structure, which provides a backlog of confidence for those companies who have invested substantially in vinyl foam development work and production facilities. It is also reassuring to end-product manufacturers who have redesigned old products and developed new ones based on the large-volume availability of vinyl foam in various forms.

Plastisol Technology

The second basic factor responsible for the rapid

* Based on a paper presented at the twelfth annual National Technical Conference, Society of Plastics Engineers, Inc., Cleveland, O., Jan. 19, 1956.

growth of the vinyl foam industry is perhaps the most important but the least appreciated. I am referring, of course, to the use of the plastisol compounding techniques. To our way of thinking, this technique is one of the most unique phenomena of the plastics industry, although little understood and not widely used until just a few years ago.

Plastisols, or paste resins as they were called initially by both the Germans and ourselves, for some time were thought to be of little importance. During the last 10 years, however, perfection of the so-called "stir-in" PVC's has opened up enormous new fields for vinyl resins using the plastisol technique. Vinyl foam, of course, is one of these new fields, although the Elastomer Process was invented prior to the general commercial availability of these types of resins. The plastisol approach also has been assisted by the development of low-viscosity plasticizers with desirable viscosity-stability characteristics.

A plastisol, also known to some as the name for a liquid vinyl compound with 100% solids, is a dispersion of finely-divided particles of PVC in a plasticizer, usually a high-boiling organic liquid such as DOP, TCP, etc. Its uniqueness stems from the fact that the plasticizers have sufficient solvating action on the resin particles to hold them in suspension at room temperature, while completely dissolving the resin particles at elevated temperatures (usually, although not always, at about 170° C.).

The fact that the conversion to the fused state takes place without exothermic reaction, without the evaporation of volatiles, and without the application of pressure provides the functional uniqueness of the plastisol. If pressure were to be required in the fusing or conversion step, vinyl foam with interconnecting cells would probably not be a practical reality today.

The compounding of plastisols is extremely simple. Here, improvements in resins and plasticizers have obviated the necessity of paint mills or ball mills for the mixing operation. Simple dough mixers, change-can mixers, and Hobart-type vertical mixers are more than adequate for the compounding step. Thus, the all-important versatility in physical and chemical characteristics of vinyl foam is readily attained. This inexpensive equipment is all that is required for the simple one-step compounding procedure, since de-aeration is not needed for foam plastisols. The vinyl chemist can build into the finished foam product the properties he desires as easily as the baker does in selecting a particular cake or bread dough recipe.

Production Techniques

This brings us to the third factor in the unfolding of the vinyl foam industry; the development of adequate equipment and suitable production techniques for practicing the Elastomer Process on a large-volume production basis. The overall and basic reason for being of the Elastomer Process is that today, at least, the supremely important versatility of the vinyl plastisol technique cannot be adequately applied without it to the large-volume production of low-density vinyl foam of top quality.

The Elastomer Process provides a method of pre-expanding the plastisol by using mechanical gas-absorption techniques. The expansion step and method is sufficiently separated from the fusion or curing step so as not to unduly complicate or restrict methods of performing either step. We are able to control the many operating variables by positive and purely mechanical means; consequently, we can formulate our plastisol compounds in terms of the foam end-product requirements without regard to foaming techniques. This allows us to draw on the full range of versatility which is characteristic of vinyl plastisol compounds.

In addition to the concept of product versatility, the Elastomer Process also permits volume production of high quality, low density foam. It is for this reason that adequate continuous processing equipment and established manufacturing techniques are so important to successful vinyl foam production. If our objective was either good quality or low density, our problems would be simplified, particularly if large-volume production was not required. We have learned that foam production problems are directly proportional to production rates and inversely proportional to density.

It is quite simple to make an excellent quality vinyl foam of 10-pound density, and it is not very difficult to make a five-pound density vinyl foam of poor quality. Similarly, it is far simpler to make continuous slab foam 12 inches wide and two inches thick at slow speeds than to produce sheet foam 54 inches wide and four inches thick at a speed of three feet per minute, or to produce a cored cushion measuring 15 by 15 by 2 inches, as opposed to a mattress 54 by 76 by 4½ inches in size. It is only when higher production rates and larger objects are desired that low density and high quality evade the grasp of the naive and inadequately qualified producer.

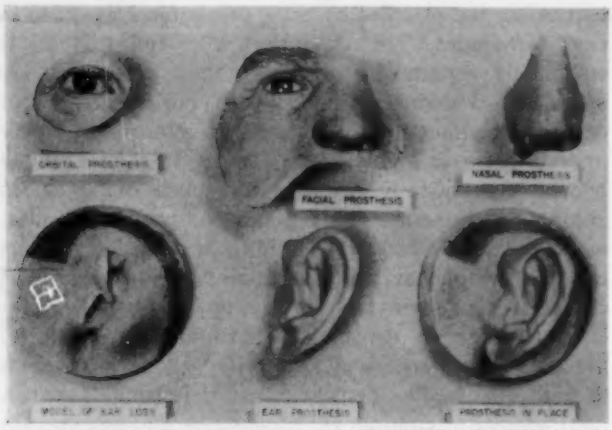
It might be well at this point to explain what we mean by high quality, low-density vinyl foam. Except for certain semi-rigid specialty items, the market for vinyl foam at densities in excess of seven pounds per cubic foot is very limited because of weight and economic considerations. By low density, then, we mean a product within the range of 3.5-7 pounds per cubic foot. By high quality, we mean a foam product which is completely fused, has a completely homogeneous cell structure, has uniform density, has desirable stress-strain characteristics, and is judiciously formulated from the standpoint of plasticizer selection.

Since both equipment and techniques for achieving this combination of objectives are now available, we have at hand the three basic factors which made possible the spectacular growth of the vinyl foam industry.

The Elastomer Process

Dr. E. H. Schwencke, the inventor of the Elastomer Process, began intensive research on blowing agents shortly after World War II. Early in 1949, he discovered the basic gas absorption techniques which we still follow. Starting with a whipped cream dispenser having a one-pint capacity, various counter-current, agitation techniques and temperature controls were the subjects of many experiments.

The first use of the Process was by the Veterans Administration which has produced many hundreds of



Courtesy: Veterans Administration

Fig. 1. Facial restorations, using vinyl foam with solution-type vinyl skin covering.

artificial limbs, artificial breasts, and facial restorations (see Figures 1 and 2). These prosthetic devices originally used the same integrated skin technique that has been carried over to arm rests and other present day commercial products. Today, a solution vinyl "skin" is usually preferred to cover the foam. The whipped cream dispensers still are adequate for their purposes. The first production use of the Process came in 1950 and, by that time, we were using a two-gallon tank for mixing. Over one million vinyl foam novelty animals with sprayed skins were made that year.

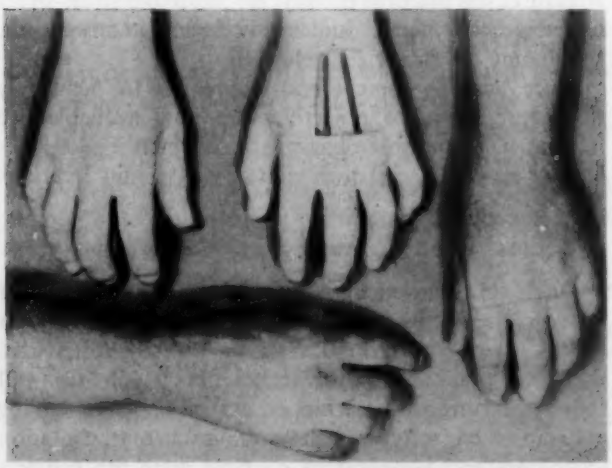
Between 1950 and 1952, we learned the hard way that there was no market for a high-density vinyl foam of poor odor and color stability. Late in 1952, however, we made important strides in our compounding knowledge and sufficiently impressed the Bakelite Co. that they saw fit to make our process the subject of a substantial publicity program. The publicity was successful, but the patient almost died. We processed some five thousand inquiries indicating a tremendous latent interest in vinyl foam, but we wound up the year with our most substantial deficit. When the chips were down, we found no greater interest in an 8-12 pound density foam than we had encountered when trying to exploit a 12-20 pound density foam in prior years.

The years between 1951-1954, however, were devoted to the evolution of the Elastomer Process as it exists today. This included the introduction of the all-important concepts of continuous foaming and high frequency fusing. The inclusion of such equipment in our pilot plant (see Figures 3, 4, and 5), through the cooperation of The Girdler Co., indicated the potential of our process. These developments permitted the launching of our licensing program, and the stepping up of our research activities. Progress since then has been spectacular, and the success of vinyl foam is indicated by its acceptance by so many highly diversified industries.

Applications of the Process

Our program received an important impetus in 1954 when Chrysler specified an all-vinyl arm rest on 1955 Plymouths and most of their other models. This arm rest consisted of a non-expanded skin that was slushed or rotationally cast against an embossed inner wall of the mold. A metal mounting plate acted as an insert in the mold whose remaining voids were filled with foam. Several of our licensees lacked the equipment and know-how for using our Process on these arm rests, so that only one of the five original suppliers used it from the start. When production of this item terminated in 1955, two of the other suppliers were using the Elastomer Process. In addition to the Chrysler arm rests, both arm rests and crash pads were produced for American Motors by our process.

The first important non-automotive industrial application was for full vinyl foam seat cushions for the New York City subways. As the largest passenger railroad in the world, this is big business; over 1,000 cars have been ordered during the past year. Initially, the foam cushions were produced either uncored (using high frequency) or with coring (in hot air ovens). Because of difficulties with mold materials, most cushioning is now being made in cored aluminum molds using conventional hot air ovens. Vinyl foam's continued acceptance by the N.Y.C. Transit Authority and its suppliers for recent orders is based on its fire resistance and its superior cushioning qualities at lower cost than competitive materials.



Courtesy: Veterans Administration

Fig. 2. Artificial hands: a cosmetic glove is drawn over a vinyl foam inner form molded around an armature for attachment to wrist fitting (as shown in cut-away view).

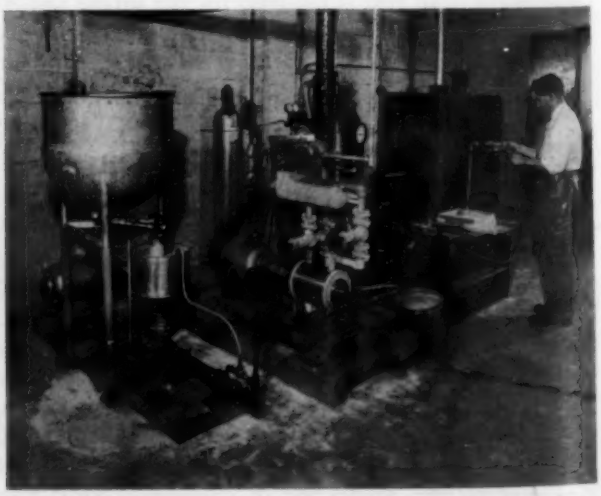


Fig. 3. Original Rotator foamer installation in Elastomer pilot plant followed the introduction of the concept of continuous foaming.

Another interesting non-automotive cushioning application has involved the development by Brown Rubber Company, working in cooperation with American Seating Co., of the first fire-resistant foam-cushioned seats for school buses. These cushions have the familiar sprayed or slush molded skin which affords a tough and long-wearing yet easily cleanable surface for the foam underneath. In making this product, mold costs are comparatively low because no metal inserts are required.

The newest automotive applications for vinyl foam are the sun visors for the 1956 Ford and Mercury. Of particular interest in this application was the substitution of a heat-sealed vinyl film over the foam for the troublesome slush-molded skin previously used for arm rests and other products. Since this product has a large surface area in relation to its size and cost, the risk of the occurrence of a slight surface imperfection is too great. The problem was solved by molding the foam either in two halves or in one piece around the visor insert, and then heat-sealing vinyl film with a tear-seal die around the molded foam assembly in order to complete the product. This operation can be further simplified by vacuum forming the film before it is heat-sealed. The formulation problem on this particular application was to obtain high compression while still keeping down the overall weight of the visor.

Early in 1954, Elastomer Chemical installed electronic heat-sealing equipment as part of the pilot plant demonstration procedure. The ideal and unbeatable heat-sealing characteristics of vinyl foam are used today on some 300 different applications. These include slippers, toys, brushes, bath mats, pocketbooks, wallets, brassiere inserts, belts, and numerous other apparel and novelty items. A few of these articles are shown in Figure 6.

Vinyl foam sheet stock is also being used for producing quilted stocks for automotive and other upholstery applications. Vinyl foam may be directly heat-sealed not only onto vinyl film, but also to practically all natural and synthetic fabrics. No interlayers or coating treatments are necessary, since the heat-sealed foam flows into the interstices of the fabrics. The increasing cost advantage of vinyl foam and its superior cushioning qualities are expected to bring substantial increases in its use for furniture toppers and full foam cushioning during 1956.

Cushioning Qualities

The expression "superior cushioning qualities" which we claim for vinyl foam should be clarified. Cushioning comfort has not yet been defined in engineering terms, nor can it be described in terms of compression resistance or hardness alone, as has been done with non-synthetic foam materials. We believe that functional cushioning will eventually be evaluated in terms of the stress-strain curve, the effect of preflexing, rebound or resilience, and, above all, aging characteristics.

We can visualize several different types of desirable cushioning qualities. For shock cushioning, as typified by automotive crash pads, the required properties appear to be hardness, high compression, and high energy absorption with low rebound. These qualities are comparatively easy to obtain, particularly with vinyl foam where increased hardness does not necessarily involve increased cost.

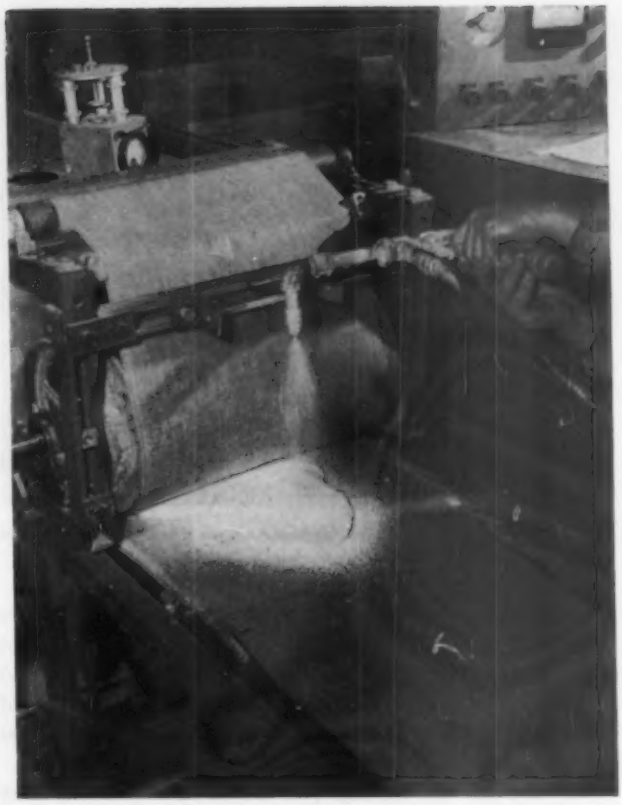


Fig. 4. View of early vinyl foam conveyor discharge in Elastomer pilot plant. Top belt has since been replaced by knife, and the spray area is now fully enclosed.

Still another specialized type of cushioning is required for bed pillows. Here, the requirements are extreme softness, light weight, and, above all, low rebound or resilience.

By far the most important volume potential for vinyl foam or any flexible foam material is in the seat cushioning field. This field embraces furniture, bedding, automotive, and all other transportation seating. The ideal qualities for seating in any of these uses have

Fig. 5. High frequency foam curing installation in Elastomer pilot plant.

Fig. 6. Typical electronically heat-sealed products made from vinyl foam with vinyl film covering or backing.

been under investigation for many years on a purely objective basis, without regard to any particular kind or type of material. This study will continue, but may never culminate in over-all standardization because of divergent engineering viewpoints and differing specific end-use requirements.

In many ways, springs provide ideal seat cushioning requirements. Figure 7 shows a stress-strain curve for a coil spring. Within its elastic limits, this curve is a straight line. Furthermore, the permanent set of a good spring is comparatively low. We all know, however, the obvious difficulty of a spring; it supplies cushioning, but not comfort. Thus, it is necessary to superimpose on the spring construction all types of padding, wadding, and topper pads so that cushioning properties of the steel springs can be rendered comfortable and of practical value to the sitter.

Whether springs function in compression (such as a vertical coil spring) or in tension (and as a zig-zag spring), they have in common the characteristic of being placed too far apart, so that other materials must be used to spread the spring hardness over a wider surface area. It is the last feature which is provided only by a resilient foam cushioning.

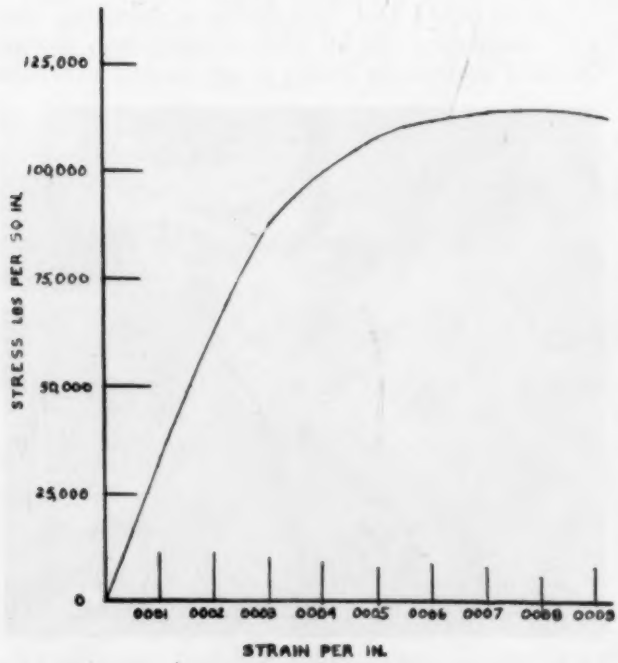


Fig. 7. Stress-strain curve for a coil spring.

A foam cushion is composed of millions of small, inter-connected cells which are actually nothing more than countless small "springs" spaced very closely. As load is applied, two things occur; the cell walls in the indented area are either stretched or compressed, and air is displaced from one section of the mass to another. Thus, the numerous cells or small "springs" spread the load in such a way that supplementary padding is not needed. Since good foam cushioning also has the dual characteristics of satisfactory stress-strain curve (see Figure 8) and low permanent set, resilient foams are the only accepted materials which of themselves provide both cushioning and comfort features.

Supported Foam Cushioning

Practically no foam cushioning is used today without some sort of spring construction as a structural under-support. Thus, foam rubber mattresses are always sold in collaboration with box springs, and even so-called full foam upholstered furniture is still supported by spring construction. In many important instances, however, foam rubber is used merely as a topper pad to provide comfort and protection from the springs which lie directly underneath and actually provide most of the cushioning and support. The most important example of this construction is in the field of automobile seat topper pads. Here the foam used is a cored, molded pad with an average thickness of only two inches which fits over the springs. This same construction is used in some so-called foam furniture, and in much non-automotive transportation seating.

Figure 9 shows a metal mold being filled with a two-nozzle foam discharge, and Figure 10 the same mold about to be closed. Full vinyl foam cushions made in this manner and having only a thin plywood or aluminum base or mounting plate are used on the New York City subways without auxiliary spring construction of any kind. (Incidentally, these cushions are upholstered with vinyl-coated fabric.) The savings in weight and assembly for this type of seating are obvious. By applying the integrated skin technique to seat cushions, it may be possible to completely eliminate the coated-fabric covering, thus escaping the high cost of the hand upholstery operation. Such a foam cushion with integral skin might have to be rendered breathable through multiple perforations of the top surface in a subsequent operation.

The specifications for such a cushion would not be easy to meet; but the cushion would be suitable not only for subways, but for full cushioning in automobiles, interstate railroads, buses, planes, furniture, etc. We predict that vinyl foam's versatility and low cost will fulfill the requirements which include the following:

(1) Comparatively light weight to reduce gross vehicle weight and provide easy handling for quick access to valves, controls, and other mechanical equipment.

(2) Adherence to stress-strain curves designed so that minor changes in load will not at any point produce either sharp changes or no changes in deflection. We describe such a product as having a comparatively high yield index, although this is merely an arbitrary designation which affords a measure of the linearity of the stress-strain curve.

(3) Comparatively low "permanent" set: at least sufficiently low to prevent excessive loosening of the upholstery or wrinkling of an integrated skin. (The actually permanent set of properly fused, open-cell vinyl foam is quite low, but much misunderstanding of this quality existed prior to 1955.)

(4) Comparatively low "temporary set" without bounciness; i.e., the cushion must recover its full dimensions quickly enough to maintain a good appearance, but not so quickly as to render the cushion bouncy or too lively.

(5) Comparative permanence of physical properties, with particular emphasis on hardness and other stress-strain characteristics. Obviously, a cushion whose comfort depends upon a specified hardness and compression will lose its comfort and other functional values if it softens appreciably during its anticipated service life. Similarly, a cushion which after being bounced upon or compressed several times shows a substantially decreased hardness, exhibits what is termed a high percentage flex loss, another undesirable foam quality.

(6) Fire resistance, if the seating is to be used in public transportation or institutional seating or bedding of any kind.

Summary and Conclusions

In this paper, we have attempted to cover several interesting phases of the new and burgeoning vinyl foam industry. The basic factors which were needed by the industry, and are available to make this growth possible. Some of the more significant applications of vinyl foam have been discussed, referring to them, in part, in historical sequence. Finally, we have discussed the enormous potential for vinyl foam in the field of comfort cushioning, and what the basic requirements are for such cushioning.

We could describe in great detail what the vinyl foam industry needs, and indeed will ultimately get, before it can realize its full potential. Obviously, these include improved resins, plasticizers, and stabilizers from the chemical manufacturers; and improved and higher capacity production equipment from engineering and equipment firms.

Our company will continue to increase both its research and sales efforts to hasten the growth of the vinyl foam industry towards our scheduled objectives. These objectives call for a gross vinyl foam production of 50,000,000 pounds per year by late in 1957, and several hundred million pounds per year sometime between 1960 and 1965.

—The End

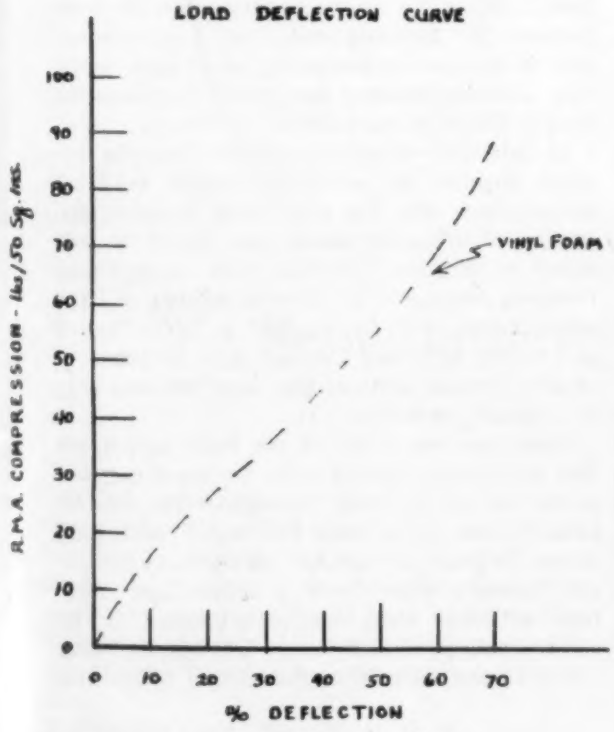


Fig. 8. Stress-strain curve for a typical vinyl foam.

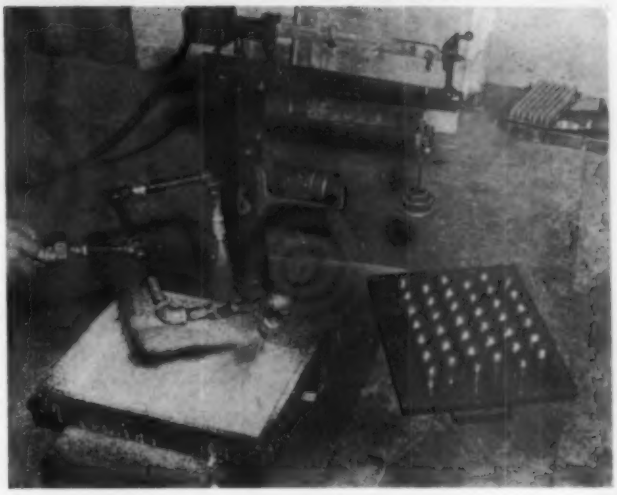


Fig. 9. Filling cored metal mold with foam from two-nozzle discharge in pilot plant.

Fig. 10. Foam-filled metal mold being covered with cored cover plate.

Guest Editorial

CLIFFORD W. BROWN,
Vice President & General Manager,
Narmco Resins & Coatings Co.,
Costa Mesa, Calif.

The Role of Structural Adhesive Bonding in Aircraft Development

No enterprise in America has faced more compelling challenges in recent years than the nation's aircraft industry. To pierce the sonic barrier and to design and build fighters, bombers, and guided missiles capable of flying at velocities, temperatures, and altitudes almost beyond comprehension a decade ago, has imposed enormous responsibilities upon the industry in whose hands our future security very largely rests.

To meet this constant challenge, the aircraft industry has been obliged, as a matter of everyday practice, to replace conventional thinking with fundamentally new design concepts and techniques. The urgency of this kind of dynamic engineering has become increasingly obvious, for modern air weapons have demanded wholly new materials and combinations of materials, as well as wholly new methods of joining materials into structural components capable of withstanding intense heat, pressure, and vibration.

One of these basic new design concepts, of particular interest to the plastics industry, has been the introduction of structural adhesive bonding, the first basically new structural fastening method to become available to industry in more than half a century.

To the aircraft industry, structural adhesive bonding has opened up a variety of arresting design potentialities. For example, it has replaced riveting, welding, brazing, and other conventional fastening methods in the production of structural components for a wide variety of modern aircraft, enabling them to fly higher, faster, and farther. Because of its unique structural efficiency, adhesive bonding avoids the familiar pattern of stress concentration inherent in riveted construction. In contrast, it more evenly distributes aerodynamically-induced loads throughout a bonded structure, making for stronger, more durable components. By avoiding such load concentrations and by its inherent dampening effect upon vibration, adhesive bonding has greatly increased the fatigue life of primary aircraft structures.

In addition, structural adhesive bonding has made possible the use of lightweight sandwich construction, and has also made practical the joining of dissimilar metals that would be subjected to extreme corrosion with conventional fastening methods. The adhesive bonding of large areas of wing skins has resulted, as in the case of the Boeing B-52 and Convair B-36 bombers, in smooth exterior surfaces that have reduced drag by a significant margin.

These are but a few of the basic advantages that have been responsible for the rapid increase in the use of adhesives throughout the aircraft industry and, to a lesser but highly interesting degree, in many non-aircraft industries. A laboratory curiosity slightly over a decade ago, structural adhesives today are being utilized in the construction of virtually every air weapon being added to the arsenals of the United States and

Canada.

As aircraft design requirements have become more and more exacting, structural adhesives manufacturers have continued to improve the physical characteristics of their products to the point where adhesives available today are many times stronger, more heat-resistant, and more durable than those available only a few years ago. As recently as five years ago, in fact, the "heat barrier" for adhesives was 250° F., then, it rose progressively to 400° and 500° F. Today, some adhesives maintain their physical integrity at temperatures of 700° F., and even higher for limited periods of time.

In the aircraft industry, however, tomorrow's requirements are today's design challenge, and tomorrow's adhesive requirements may well be in the 1,200-1,500° F. range.

An interesting example of the constantly mounting demands of the aircraft industry is reflected in the progressive redesign of helicopter rotor blades. Initially, the industry utilized riveted steel blades. Then, in the constant search for greater strength with minimized weight, it turned to adhesive-bonded rotor blades. Finally, design and development work is going forward today on the idea of utilizing a gas-turbine exhaust to whirl rotor blades like a supersonic water sprinkler, and at temperatures of 400° F. To bond such jet-propelled rotor blades will require structural adhesives of exceptionally high heat resistance over prolonged periods of time.

The requirements of tomorrow's structural adhesives are, thus, already clearly defined on aircraft designing boards across the nation.

Like the metallurgical sciences that drew constantly higher properties from conventional alloys and eventually turned out a variety of new "wonder metals," the structural adhesives industry is confronted today with the urgent responsibility of exploring wholly new combinations of basic chemicals as the potential key to the structural adhesives of tomorrow.

We at Narmco believe that the future of aircraft adhesives lies in the test tubes and beakers of our experimental chemists. Already, our research endeavors have led to highly promising results in the application of silicone polymers in new high-strength, high heat-resistant metal-to-metal adhesives.

Meanwhile, in our laboratories, chemists are evaluating and re-evaluating a wide variety of basic chemicals in a diligent search for the answer to these challenging future requirements. This work is painstaking, time-consuming, and costly, but it is our philosophy that the air weapons of tomorrow will utilize structural adhesives that are in the test-tube stage today.

This, we feel, is the future, and a bright future indeed, for one of America's youngest yet most dynamic plastic industries that is dedicated to the production of constantly better structural adhesives.

—The End

Epoxies Save "Poor Butterfly"

Oakland Park Department's climbing toy made durable through use of Epon resins.

Still another use has been found for Epon epoxy resins by the Oakland, Calif., Park Department. One of the children's favorite climbing toys, a large free-form construction known by them as the "butterfly," was being worn down to a caterpillar. Made from layers of fiber glass cloth laminated on a steel pipe frame, butterfly was subjected to wear unknown to most reinforced plastic structures.

Shell Chemical Corp., New York, N. Y., manufacturer of Epon resins, compounded a special formulation for repairing the butterfly, and donated it to the city of Oakland. Layers of glass cloth soaked in the resin were stretched over the frame, and allowed to dry and harden. After sanding, small redwood steps were glued to the side with an Epon adhesive. The entire form was then sprayed with three coats of the resin mixture, the final coat being colored.

—The End

A. J. Cheney, Jr.

W. B. Happoldt

K. G. Swayne

Zytel and Teflon Resins as Bearing Materials—Part II

The conclusion of a two-part article discussing the properties of these resins that make them advantageous for bearing applications.

A. J. CHENEY, JR., *Sales Technologist,*
W. B. HAPPOLDT, *Supervisor of Sales Service Laboratory,*
and
K. G. SWAYNE, *Research Engineer,*
E. I. du Pont de Nemours & Co.
Wilmington, Del.

Basic Properties of Zytel Nylon

Zytel 101 is the highest melting and stiffest of the commercial nylons available today, and the general properties of this resin are given in Table 8. Of particular importance is the coefficient of thermal expansion, since it is several times as large as those of the metals often used in bearing applications. Several types of hardness test results are reported for comparison. The values given are for average air exposure, since the moisture content of the material does affect the values.

All nylons are hygroscopic; that is, they will pick up moisture from the surroundings until an equilibrium condition is reached. Since best quality moldings are obtained if the molding powder contains less than 0.3% water, the moldings as produced will absorb water. The amounts absorbed and the dimensional changes to expect for several environments are shown in Table 9.

Once these dimensional changes have taken place, further change with normal variations in environmental conditions is small. Water diffuses through Zytel very slowly. The rate of change in moisture content as it affects the inside diameter of bearings is shown in Figure 5. Annealed bearings exposed either to air at 50% relative humidity or to water show a dimensional growth for the first few months; after that, the change is small. Bearings exposed to room conditions for one year with normal variations in relative humidity, changed less than 0.001 inch per inch after the initial growth.

From these data, the importance of moisture conditioning the bearings to or near the equilibrium condition is evident. Moisture conditioning for wet applications can be done in boiling water. Conditioning to 50% relative humidity, as for average air exposure, is not as easy and methods are being investigated. A practical method is to boil the bearings until approximately 3% by weight of water has been absorbed. Boiling times for this method are shown in Table 10. Then, if these parts are allowed to sit in air for a week or two before use, the excess moisture on the surface will have evaporated and most of the dimensional change will have taken place. It is obvious that bear-

ings should be sized so that the dimensions will be correct at the equilibrium conditions expected.

Strength and stiffness properties also are dependent upon the moisture content. One of the more important effects of moisture is that it increases the impact resistance. The impact resistance of parts conditioned for average air exposure is twice that of the "as molded" condition. Tensile strength varies with temperature, as shown in Table 8. These values are for parts in equilibrium with average air exposure; if saturated with water, strength values 10% lower should be used. Dry parts as molded would have a strength approximately 10% higher at each temperature.

Stiffness or deformation under compressive loads can be calculated from the modulus of elasticity. The modulus is independent of the stress up to approximately 3,000 psi. Thus, if a bearing with a 0.100-inch wall is under a compressive load of 400 psi., the initial unit deformation at room temperature would be 0.002 inch per inch (400 divided by the modulus of 200,000). Since the wall is only 0.100-inch thick, the total deformation is 0.0002 inch.

Modulus values vary with temperature and moisture content, as shown in Figure 6. Except for parts as molded, the dry values are seldom encountered. For most work, values can be taken safely from the line marked "average air exposure," and will represent the actual values for parts moisture conditioned to 2.5% water.

Deformation with time while under load, usually called creep or cold flow, should also be considered. Marin (10) demonstrated that a part under a compressive stress will deform with time as shown in Figure 7. Parts at room temperature and average moisture content will initially deform 0.009 inch per inch at a stress of 1,800 psi., or a little over 0.002 inch per inch at 450 psi. If the load is applied continuously, the deformation will continue until it is about twice the initial change in 200 hours; beyond this time, little deformation takes place.

A simple, yet accurate, method for determining the creep or cold flow is to consider the continued deformation as a change in modulus with time. Thus, from Figure 6, the initial modulus is 200,000 psi. Yet in approximately 200 hours, the material has deformed as though

Table 8. Properties of Zytel 101 Conditioned to Average Air Exposure.

Melting point, °F.	485
Coefficient of thermal expansion, in/in./°F.	5.5×10^{-6}
Thermal conductivity, Btu/hr./sq.ft./°F./in.	1.7
Hardness: Rockwell "R"	118
Knoop	6.5
Tensile strength, psi.:	
At —60° F.	14,000
At 73° F.	9,300
At 190° F.	6,000
Fatigue endurance limit, psi.:	
At 73° F.	3,000
At 212°	2,000

Table 9. Moisture Absorption and Dimensional Change of Zytel 101 Molded Bearings.

Environment	Moisture Content, % by Wt.	Change of Inside Dia., Inches/Inch of Dia.
As molded	Less than 0.3	—
Average air exposure	2.5	+0.006
In water	8.5	+0.025

Table 10. Boiling Times for Moisture Conditioning of Zytel 101.

Wall Thickness, Inches	Boiling Time, Hours
Average air exposure:	
0.060	0.5
0.090	1.2
0.125	6
0.250	18
Wet applications:	
0.060	4
0.090	10
0.125	50
0.250	180

Table 11. Coefficients of Friction for Nylon.

	Nylon on Nylon		Steel on Nylon	
Lubricant	Static	Kinetic	Static	Kinetic
Dry	0.46	0.37	0.37	0.34
Water	0.52	0.33	0.23	0.19
Ethylene glycol	0.58	0.19	0.20	0.16
Glycerol	0.36	0.19	0.23	0.18
Perfluorolube oil	0.58	0.24	0.30	0.19
Oleic acid	0.29	0.13	0.15	0.08
Polymethyl siloxane (DC 500)	0.43	0.17	0.19	0.12

Table 12. Spread in Coefficient of Friction Data for Nylon (Applied loads, 1-5 Lbs.; Sliding Speeds, 8-367 Ft./Min.).

No lubricant	Nylon	Nylatron G
Max.	0.33	0.33
Min.	0.15	0.22
Water		
Max.	0.18	0.21
Min.	0.14	0.19
Oil		
Max.	0.14	0.13
Min.	0.09	0.08

Table 13. Safe PV Values for Zytel 101 Bearings.

Lubricant	Continuous Operation	Intermittent* Operation
Dry	500-1,000	3,000
Water	1,000-1,500	4,000
Oil, initially	2,000	8,000

* Where shaft is in motion approximately one-third of time, and in continuous operation less than 15 minutes per cycle.

the modulus were one-half this or 100,000 psi. This value can be called an apparent modulus, and its value as a function of time is shown in Figure 8. These data are for Zytel at room temperature and containing moisture corresponding to average air exposure. For other environmental conditions, the apparent modulus can be estimated by starting with the appropriate initial modulus at the left and drawing a curve parallel to the one shown in the Figure.

For example, suppose a bearing with a 0.060-inch wall will have a maximum uint loading of 400 psi. The bearing will operate in air with a maximum temperature of 150° F. What deformation would be expected if the bearing were loaded for 1000 hours or longer? Assuming that the bearing is at average moisture content, the modulus at 150° F. is 100,000 psi. We can estimate from Figure 4 that the apparent modulus beyond 1,000 hours would be 45,000. Then, deformation is 400 ÷ 45,000, or 0.009 inch per inch; and maximum deformation is 0.009 x 0.060, or 0.0005 inch.

For high temperature applications where long-time exposure to temperatures above 170° F. is expected, the heat-stabilized composition FE-2129 should be used. This material retains its properties for over 50,000 hours at 250° F., and approximately 2,000 hours at 300° F. Otherwise, its properties may safely be taken as the same as Zytel 101.

Various data on coefficient of friction for Zytel are given in the literature. Since the type of test and the conditions used determine to a large extent the values obtained, comparison between two sources is difficult. Data (11) obtained with a modified Bowden-Leben type stick-slip machine are shown in Table 11. These results were obtained at very low surface speeds; approximately ¼-inch per minute.

Milz and Sargent (5) concluded that so many factors affected the coefficient of friction that a range should be reported (see Table 12). Their data were taken with a crossed-cylinder apparatus. The general effects of water and a lubricant are shown in the Table. They also reported considerable data on the effect of varying the load and speed.

Early work on sleeve bearings was reported by Wall (11). Much of this work was done under an investigation sponsored at Battelle Memorial Institute, and indicated that completely dry bearings of Zytel could be used for limited loads and speeds. The addition of water slightly improved the bearing performance, and the addition of lubricating oil improved it greatly.

One difficulty encountered in this work was the maintaining of proper clearances. As previously explained, Zytel parts must be sized so that the desired dimensions will be obtained when the parts are at equilibrium with the service environment. By annealing and moisture conditioning as required, inside dimensions can be held to plus or minus 0.001 inch per inch or less.

Also of importance is the change in inside diameter due to press fitting the bearing in its holder. For cylindrical bearings with wall thicknesses up to at least ⅛-inch, essentially all the interference results in a proportional decrease in the inside diameter. For example, when nominal one-inch diameter bearings with a 0.1-inch wall are pressed into a holder with 0.010-inch interference, the inside diameter decreases 0.008-0.010 inch.

Properly designed bearings for dry or partially-lubricated operation should have a clearance of 0.004-0.006 inch for a one-inch bearing. Larger bearings can have proportionally less clearance.

Operating conditions for these bearings can be estimated from the PV values given in Table 13. The PV value is the product of the load, (in psi.), on the projected area and the surface velocity (in feet/minute). Since heat seems to be the primary cause of failure, this value can be used for design over a wide range of loads and speeds. The presence of water will permit increased loads or speeds, and one shot of oil or grease increases the permissible range even more.

While the bearings may seize and fail if temperatures become excessive, properly-dimensioned bearings can be run with a temperature rise of 100° F. or higher if ultimately stable conditions are reached. The higher temperatures undoubtedly result in increased wear rates, but little data have been obtained.

Selecting the Resin

Since both Zytel and Teflon are used in bearings, the question often arises as to which material should be used. Obviously, each application has to be judged on its own requirements, but some general guides can be established:

(1) At room temperature, Zytel is much harder, stronger, and more resistant to abrasion and deformation than is Teflon. At elevated temperatures, the reverse is true. If the expected operating temperature is relatively low, Zytel is the strong candidate.

(2) Teflon can be used absolutely dry, whereas Zytel should preferably be given some lubrication. If the part cannot be lubricated, Teflon is often the choice at severe speed conditions, since the coefficient of friction of completely unlubricated Zytel is higher than that of Teflon. The top rolls of textile machines illustrate this point; Zytel is used on the relatively low speed back rolls, while Teflon is preferred for the faster front rolls.

(3) Zytel has generally good chemical resistance to most materials and seldom encounters any difficulties on this score. In those cases where severe conditions do exist, Teflon is to be preferred; for instance, it is found on pumps and centrifuges handling acids.

There have been enough applications developed and now in use commercially to demonstrate that there is a place for unlubricated or partially-lubricated bearings of Zytel or Teflon. A field that has not been explored so well is that for lubricated bearings.

Lubricated Zytel Bearings

It had been observed on several occasions that the performance of Zytel 101 as a sleeve bearing could be improved with a few drops of oil much more than might be expected with metal bearing materials. Therefore, a program of testing was begun to determine the effects of design and operating variables on the load-carrying capacities of these bearings when oil lubricated at extremely low rates of flow.

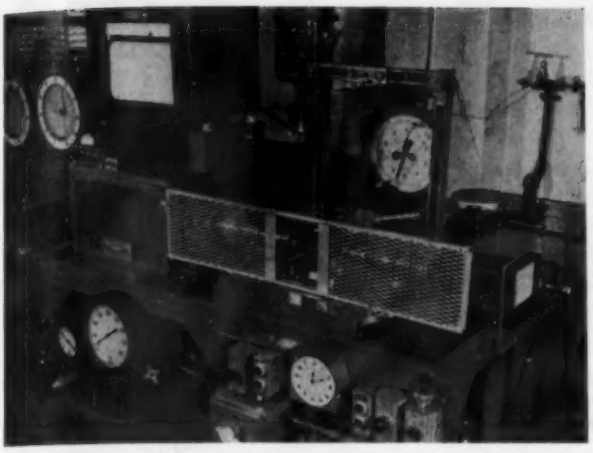


Fig. 9. Bearing test unit.

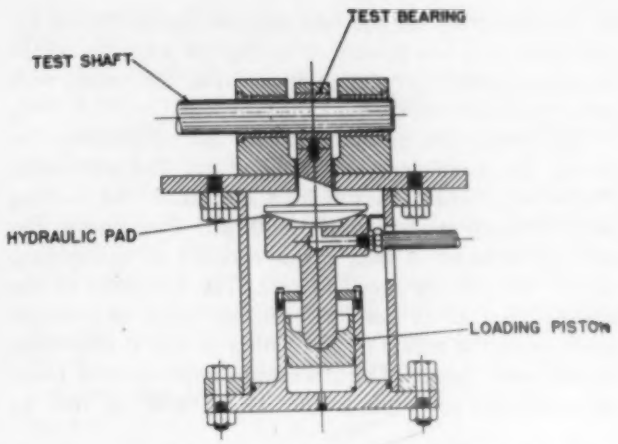


Fig. 10. Cross-sectional view of bearing test loading mechanism.

Test Conditions

As a result of some exploratory tests, several variables were suspected to have a significant effect on bearing performance, and were selected for this study. These are load, speed, clearance, and sleeve wall thickness. Other variables were held nearly constant, as follows:

Geometry:
- Shaft diameter ..... One inch
- Bearing length ..... One inch
- Bearing press fitted with 0.005-0.010 inch interference inside a cylindrical housing, and the inside diameter then machined to size.

Surface finish, micro-inches rms.:
- Bearing 35-50
- Shaft 14-16

Lubricant:
- Spindle oil; S.U.S. viscosity, 300 at 100° F. and 52 at 210° F., fed at the rate of 300-400 mg. or 10 drops/hr.

Materials:
- Sleeve bearing ..... Zytel 101
- Shaft .. Centerless-ground steel drill rod
- Bearing Holder ..... Steel

Environment:
- Conditioned air; 45-60% R.H. and 73-77° F.

Tests were conducted in the bearing tester shown in Figure 9. The load was applied by a hydraulic piston through spherical surfaces separated by a thick oil film (see Figure 10). This system gives the bearing holder assembly freedom to rotate under the influence of bearing torque. By restricting this freedom with a spring scale, the torque can be measured. The system also provides self-alignment of the test bearing.

To insure maximum accuracy of the torque measuring system, it was necessary to minimize all other moments on the bearing holder assembly. This required static balancing of the holder assembly to eliminate the gravitational moment, and horizontal positioning of the center of the bearing within 0.0005-inch of the center of the spherical surfaces in order to reduce an error moment on the applied load of 20% of the correct torque at values for the coefficient of friction of 0.005. This positioning was done by set screws before each test. To determine the accuracy of positioning, the test shaft was disconnected from the power source to permit it to rotate freely in the two needle bearing supports. If a torque on the bearing holder was observed upon application of the load, the set screws were adjusted until this torque disappeared.

The bearings were lubricated through a hole in the top (unloaded side) by gravity flow through a fine orifice under constant head. All test bearings were pressed into the holder, and bored with an accuracy of $\pm$ 0.0001. A thermocouple was mounted at the surface of the shaft under the bearing, and the signal brought out by means of slip rings. Shaft temperature, bearing torque, and room temperature were recorded continuously.

In preliminary tests, it was shown that no measurable wear was observed in several days of continuous running under moderate loading. Under such conditions, the torque and temperature remained constant. However, if the load was raised too high, three things were observed to occur; the torque and temperature fluctuated erratically, the coefficient of friction began to rise, and some evidence of wear was observed. It was established, therefore, that for each test bearing at each speed, the load would be increased slowly step-wise permitting temperature equilibrium to occur before further increase, and that the load would not be raised beyond the point where the torque and temperature began to fluctuate.

Each bearing was tested in this manner at 600, 1,000, and 2,000 rpm. In most cases, the bearings were run overnight or over a week-end at some constant load (usually 70-90% of the maximum experimental load). Total running time was 30-80 hours for each bearing, after which measurements of inside diameter did not indicate that any wear had taken place.

Test Results

A typical plot of the bearing friction torque and temperature rise is given in Figure 11. The coefficient of friction vs. bearing load is shown in Figures 12 and 13 for two of the test bearings. The data in Figure 11

is at 1,000 rpm. for the bearing reported in Figure 13. The data also are presented in Figures 14, 15, and 16 in a form which permits comparison of the results with hydrodynamic theory.

The results are plotted showing the relationship between the coefficient of friction and the parameter P/ZN for several values of load, clearance, and bearing wall thickness at a speed of 1,000 rpm. P represents the average pressure in psi., Z the viscosity in centipoises, and N the journal speed in rpm. The inversion of the conventional ZN/P results from the desire to examine more easily the region of low values of ZN/P where the higher loads occur. The maximum experimental loads are indicated on each graph. These tests, as well as those for 600 and 2,000 rpm., are summarized in Table 14 showing the maximum experimental load, temperature rise above ambient and coefficient of friction at that load, and the minimum coefficient of friction.

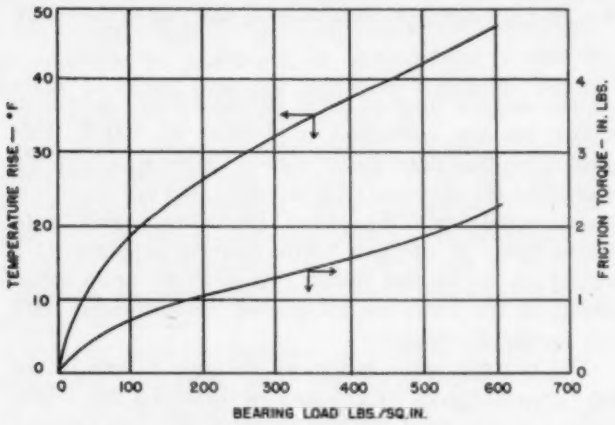


Fig. 11. Relationship of temperature, torque, and bearing load for Zytel 101 bearings.

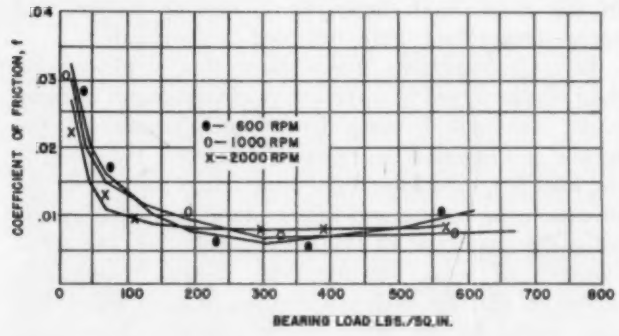


Fig. 12. Effect of bearing load on coefficient of friction of lubricated Zytel 101 bearings (0.021-in. wall, 0.0085-in. clearance).

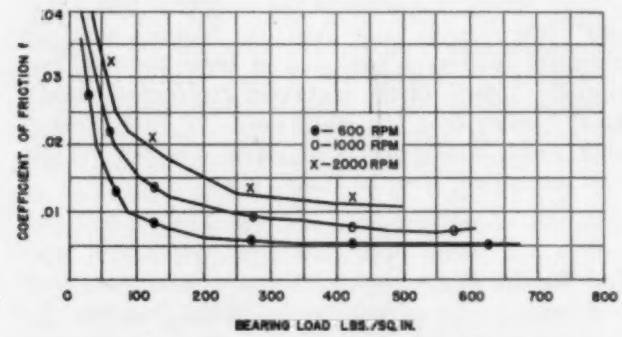


Fig. 13. Effect of bearing load on coefficient of friction of lubricated Zytel 101 bearings (0.049-in. wall, 0.0025-in. clearance).

The experimental results are compared with the theory developed by Blok and van Rossum (13) for a flexible hydrodynamic bearing consisting of a thin strip of foil wrapped 180° around a rotating shaft and loaded in tension. Involved in the derivation of this theory is the assumption of constant oil film thickness and pressure. The experiments showed very little end-leakage of oil from the bearing, as compared with conventional bearings of rigid materials. This agrees well with the experimental results of Blok and van Rossum with the foil bearing. Comparison is also made with the classical hydrodynamic theory for rigid bearing materials developed by Reynolds (14).

Considering the low rate of oil feed (less than ½ cc./hr.), support of the high experimental loads by a hydrodynamic oil film was not expected. Nevertheless, the fact that the coefficients of friction are shown to be comparable with those predicted by hydrodynamic theory, plus the fact that negligible wear was observed after 50 and more hours of operation at these high loads, indicate the probability that the loads were carried by hydrodynamic action. In several of these experiments, the drip-feed lubrication system was removed completely from the test bearing for periods of 24 hours and more while loads of 500-700 psi. were carried at 1,000 rpm. without observed wear or an increase in torque or temperature.

At the time of this writing the bearing with 0.0085-inch clearance and 0.0094-inch wall thickness has been

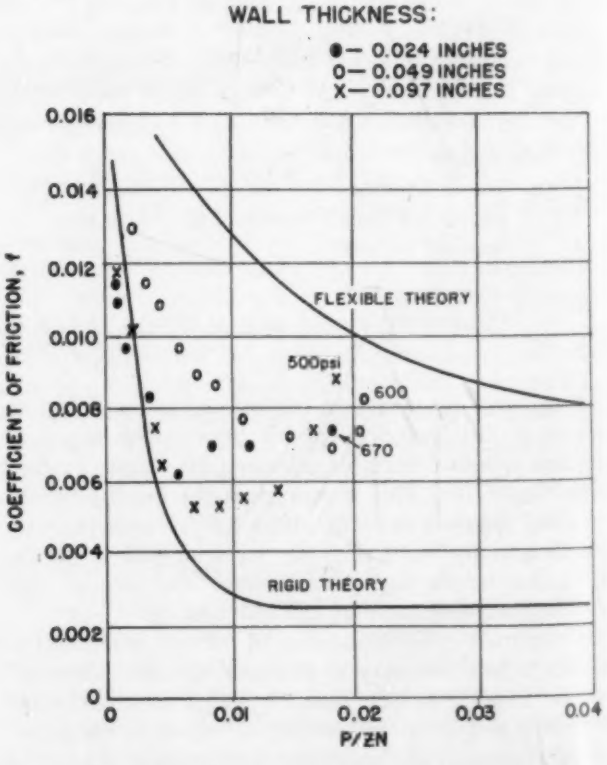


Fig. 14. Effect of coefficient of friction on performance parameter of lubricated Zytel 101 bearings (speed 262 ft./min.; clearance 0.0025-in. wall; thickness, as indicated).

running for 550 consecutive hours at 1,000 rpm. and 600 psi. load. While the bearing was lubricated initially, no lubricant has been added during this time. The torque and temperature have maintained constant low values consistent with hydrodynamic theory. Critical examination reveals that a substantial amount of oil remains in the bearing area; the leakage rate, if any, being extremely small.

The observation of low end-leakage of oil for both the flexible film bearing and the Zytel test bearings indicates the ability of flexible materials to conform to the shaft to such a degree as to reduce required oil flow for hydrodynamic lubrication by several orders of magnitude.

In all cases, the data for low loads (low P/ZN) show lower coefficients of friction than those predicted by the flexible film theory. These coefficients actually are in better agreement with conventional rigid bearing theory (Petroff and Reynolds equations) for the very low loads. At the highest attained loads, the results in many cases are in better agreement with the flexible film theory, suggesting that the limiting load occurs when the elastic bearing has been forced by the load to reduce its curvature until the oil film approaches constant thickness, and that further loading leads to further reduction in curvature and consequent loss of hydrodynamic support.

It is noted that in several cases the maximum experimental loads at 2,000 rpm. are considerably lower than the maximum load at the lower speeds. This is particularly true for bearings with large wall thickness and low clearance. The explanation is that while friction torque and speed (with the attendant power loss) are responsible for temperature rise, this rise results in two types of changes in friction torque: (1) a change in oil viscosity, resulting in a tendency to reduce torque; and (2) a reduction in bearing clearance due to thermal expansion of the bearing within its rigid steel housing, tending to increase torque.

If the latter effect predominates, resulting in increased torque due to increased temperature, the situation is unstable and the temperature rise will continue until failure. Several such instabilities were observed experimentally. With the exception of the above observation, the effect of speed on maximum load and coefficient of friction was not consistent. It is evident from Table 14, however, that speed has a consistent effect upon temperature rise.

Although Zytel has a relatively low thermal conductivity, it is shown here that proper design and operation permit the sustaining of high loads while using extremely small quantities of lubricant, without causing excessively high temperatures. Actually, the temperature rise in no case exceeded 80° F., even though the low rates of oil flow could not be expected to remove much heat. This is due to the fact that the steel shaft offers an excellent heat conducting path which is more than adequate.

While it can be said that bearings made of Zytel perform well over a broad range of clearance and wall thickness, the results indicate that the greater the wall thickness, the greater must be the clearance in order to achieve optimum performance. For example, a one-inch diameter bearing with 0.0025-inch clearance performs well with a wall thickness of 0.024-inch, whereas a bearing with 0.0085-inch clearance performs better with a 0.094-inch wall thickness.

(*Continued on page 323*)

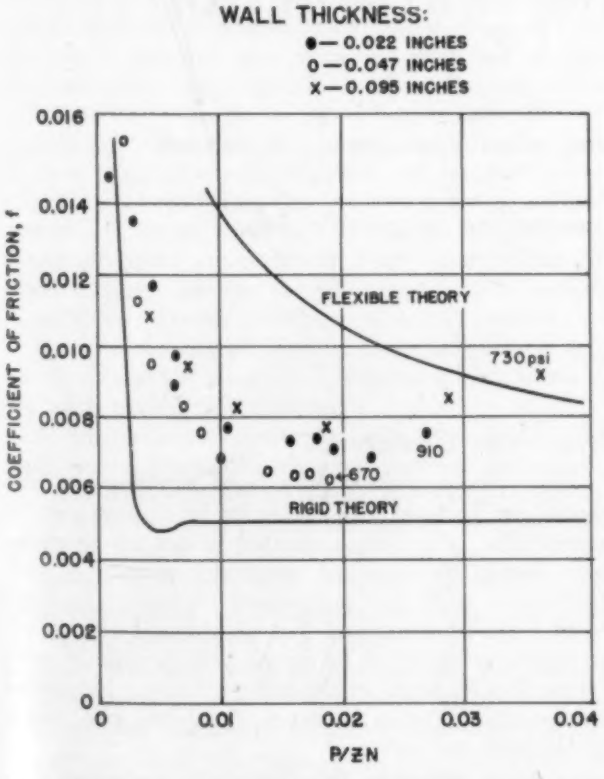


Fig. 15. Effect of coefficient of friction on performance parameter of lubricated Zytel 101 bearings (speed 262 ft./min.; clearance 0.0055-in.; wall thickness as indicated).

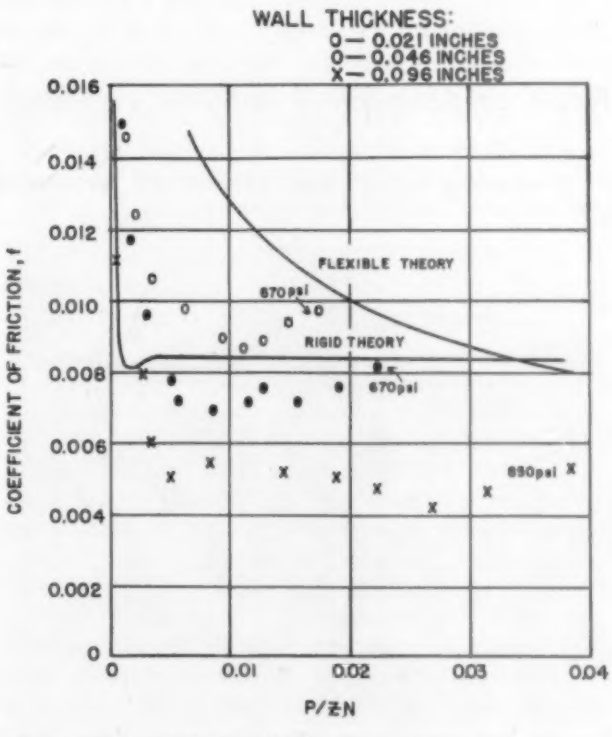


Fig. 16. Effect of coefficient of friction on performance parameter of lubricated Zytel 101 bearings (speed 262 ft./minute.; clearance 0.0085-in.; wall thickness as indicated).

CHARLES NERZIG, *Manager of Planning Department,*
Lunn Laminates, Inc.
Huntington Station, L. I., N. Y.

How Lunn Analyzes a Contract Bid and Starts a Job

Proper consideration of materials, equipment labor, plant space, etc., is needed in preparing a bid and setting up production control on a specific job.

Like most new industries, the reinforced plastics field has its problems in analyzing over-all costs for a prospective job. Because the problems in reinforced plastics are new, more probing and evaluating of materials and methods are necessary than in many other industries. Many variables must be taken into consideration in the preparation of a quotation to a customer.

At Lunn, we have devised what we believe to be a good system of estimating costs for a projected bid, and controlling operations during actual production. Our company's successful production of body parts for the first all-plastics automobile and truck body illustrates what can be accomplished in cost ascertainment and the fulfillment of production-time schedules.

Evaluation Conference

Upon receiving an inquiry from a prospective customer, our first step is an evaluation by top management (see Figure 1) to decide whether or not the proposed part should be made of reinforced plastic. At this conference with the prospective customer, management must be convinced that all the end-uses of the suggested product will be served best if made of reinforced plastic. Some of the factors that are considered are weight, corrosion resistance, durability, cost, shape of the part, and service.

In many instances, this evaluation conference will come to the conclusion that the product can be made more cheaply and last a reasonable length of time

if made of a material other than reinforced plastic. In such cases, Lunn is frank to tell the customer that reinforced plastic may be too costly or impractical for his product, and to either continue using what he has in the past or to try some other material.

Estimating System

If a conclusion is reached that it would be practical to make the part of reinforced plastic, the inquiry is fed into our system of estimating. This system begins with a conference between our various department managers. At this conference, the over-all picture is reviewed and a suggested method of fabrication of the part is determined. Quite often what may prove to be an excellent material for use in making an aircraft structural part may not be acceptable, either cost-wise or production-wise, for making a tote box or a plastic bathtub.

Some of the fabrication methods which may be employed are matched metal die molding, vacuum bag molding, contact hand lay-up, or even a combination of these methods For large production runs of 1,000 or more parts, matched metal die molding is normally the best method of fabrication. Vacuum bag molding is usually applied for shorter runs of 1-1,000 parts, or for making parts having an area of 15 square feet or more. Contact molding is employed for making smaller parts, except where the physical characteristics required of the finished part necessitates the use of vacuum bag molding. The customer's requirements and the exact specifications for the part are helpful in deciding upon a practical method of fabrication.

Another important factor that must be considered in quoting on a job is the plant space required to manufacture the parts. Availability of floor space within the plant's working area must be estimated at this time, and jobs are weighted in terms of square feet of space. For example, a part small in unit size but large in production volume may use only 80 square feet of plant space in which 200 parts can be made for a gross sale of $14,000. On the other hand, another custom job for only one unit may gross $20,000, but would use 5,000 square feet of plant space. While the profit is larger for the second item, it would absorb much more valuable working space and prohibit use of this space for any other work. Thus, the profit margin on the second job must be cut sharply in proportion to the work space it will consume.

At this point, it should be noted that both a job shop and a production shop are actively maintained at Lunn. Thus, the job shop can be working on one or more small-space jobs while the rest of the plant continues to run at full production rate. In fact, Lunn often makes its own tools or lathes for special jobs, only occasionally subcontracting for units that may be integral components of a product.

Other pertinent subjects discussed at this meeting of department managers are the materials required for the job; the availability of these materials; the approximate labor necessary; and the availability of trained personnel to do the work in time for a scheduled delivery date. To assist us in determining and scheduling the labor force for a job, we use a Control Board and an Individual Job Man-Hours Board.

Fig. 1. Typical evaluation conference by Lunn's management to decide whether a proposed part should be made of reinforced plastic. (Left to right) Mr. Nerzig; Frank Sheffler, chief estimator; J. S. Lunn, president; H. T. Douglas, executive vice president; George Chapelle, plant manager; and prospective customer.

The Control Board (see Figure 2) shows the movement of our personnel to various assignments, and indicates at a glance the availability of personnel at any given time. By means of this Board, Lunn can advise its personnel of the jobs they will be on in the near future, thus aiding the company in planning work schedules and work loads. Since our jobs vary from short to long runs, the Board is an invaluable aid in determining when a new order can be placed into actual production with full assurance that the proper personnel will be available to work on the job.

The Individual Job Man-Hours Board (see Figure 3) is another means of giving pertinent data at a glance and helping to streamline our operations. This Board shows the availability of man-hours in each section of the plant and indicates how much time is spent on a specific operation, how much time is needed to complete the assignment, and how much time is left in each section that might be put to other uses. The development and use of this Board is new at Lunn, and its painstaking development is believed to be the first of its type in the reinforced plastics field.

After all the preceding points have been cleared,

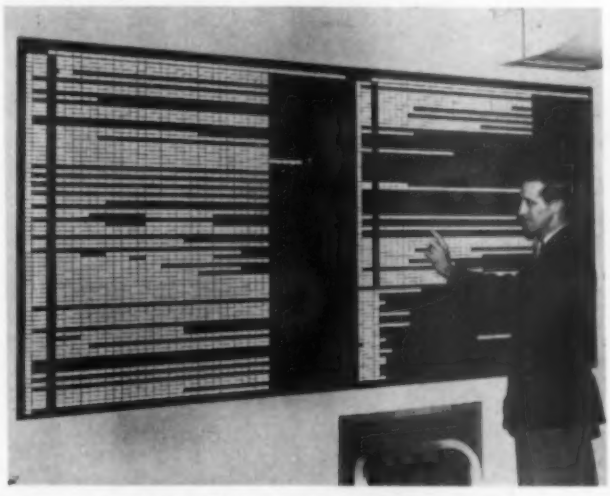


Fig. 2. Control Board shows movement of personnel to various assignments and indicates personnel availability at any given time.

the bid is passed on to the Engineering Department where the usual Estimating Cost Analysis Form (see Figure 4) is filled out. When completed, this Form will include all the data necessary to the compilation of a proper estimate. Included in this Form are a requisition section and a division for detailing the probable cost of a job. This cost analysis is used as the basic standards form when the estimate becomes a reality in the form of a purchase order.

Time spent in the laboratory to test and evaluate sample parts before production has begun also is calculated into the time-work analysis. These behind-the-scenes activities can often mean the difference in getting a job under way completely. In addition, much of the laboratory findings can be important in determining whether a specific job can be made of reinforced plastic.

Finishing and inspection operations are the final steps in completing a job order. These operations are also estimated in the over-all job-work picture. From the control boards, the man-hours spent in these operations and the amount of work done by each division of the plant can be determined. These provide good yardsticks to estimate costs and profits on similar jobs in the future.

After completion by the Engineering Department, the Cost Analysis Form is forwarded to the Purchasing Department which enters the material costs, and then sent to the Accounting Department where the man-hours are converted into labor costs in dollars and cents. After this, the Form is sent to the Planning Department which enters shipping data on the bid and, finally, to the Sales Department which contacts the prospective customer.

Setting Up Production Control

A duplicate copy of the bid is filed until the contract has been signed by the customer. Upon receipt of the signed contract, the Sales Department combines the purchase order with the original bid. A permanent job number is assigned to the contract. A copy of the purchase order with the quoted bid file is given to the Engineering Department which checks specifications of the order against the original projected bid, and prepares a "methods write-up" giving details on the actual job.

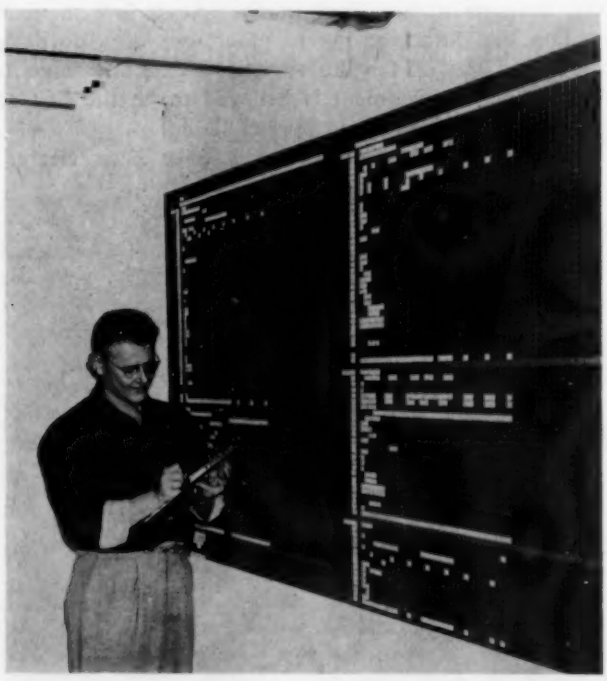


Fig. 3. Individual Job Man-Hours Board indicates availability of man-hours in each section of the company.

Approved by: SALESMAN
Date: 2-1-56 J. Doe

LUNN LAMINATES, INC.
ESTIMATING COST ANALYSIS

Inquiry No.: 2100
Date: 2-1-56
Date Bid Req'd: 2-15-56

Customer:	Drawing No.:	Quantity:
LUNN LAMINATES PROPRIETORY ITEM	LL 597	500 TO BE PRODUCED IN RUNS OF 10 ASSEMBLIES

Part	Area	Weight	Thickness
LUNN CABS	99.5 sq.	71.87 Lb. LAMINATES	.100

Suggested Method: PLUG MOLDED

Material: 1½ oz MAT GELCOTE, RESIN

Delivery: IMMEDIATE FOR 10 SETS

Amount	Materials	Unit Cost	Cost ($/PC)
91 Lb/100	1½ MAT	.50 LB.	4.51
83 LB.	941 RESIN	.36 LB.	8.28
6¾ LB.	GELCOTE	.75 LB.	4.76
	Total Material Cost:	17.35	17.35

Operations	Rate per hour	Time (Hours-Min. /PC) 500 IN RUNS 10 EACH	Cost
MATERIAL PREP	↑	3.0 HR.	5.40
MOLD SEC A	↓	39 HR.	70.20
L.T.A.	↑	8 HR.	14.40
FINISH	↓	12. HR.	21.60
INSP.	↑	0.5 HR.	.90
SHIPPING	↓	1.0 HR.	1.80
		TOTAL LABOR COST	114.30

Form #1504-Rev. (9/55)

Fig. 4. Typical Estimating Cost Analysis Form.

The "methods write-up" or Job Write-Up Form provides step-by-step instructions on the manufacture of a specific part. By means of this Form, the project engineer or supervisor can manufacture a product from start to finish.

The Engineering Department makes up duplicate files for the Production Department, the Inspection Department, and all other sections concerned with the job. All the files are left with the Planning Department and remain there until the job is actually scheduled for production. This takes place when the necessary materials and tools for the job are in the plant.

Upon scheduling the job for production, the Planning Department also uses the projected bid form to set up a time standard on the specific job. The inventories of labor, materials, and tools comprise an essential part of the over-all analysis before the work schedule for the job can be written. Charts are mapped as to estimated time schedules, with a time allowance made for delays and interruptions, so that as many snags as possible may be avoided when actual production is under way. Since the lack of a certain screw, for example, may hold up a job or even result in the loss of a contract, the previously checked inventory lists must provide complete information on type of

hardware, glass fiber and fabric grades, resin types, and other materials available.

Actual performance of the job is begun by the Production Control Department where the work schedule is planned to almost every detail. This means that the job has been broken down into man-hours of labor, costs of manufacture and time schedules have been checked and rechecked, and we now can proceed with a good idea of the entire production picture. At this stage, a man-hour production record is kept on a daily basis. After a period of time, Production Control has a more definite picture of the over-all performance and reviews the work being done against the estimated time schedules drawn up when the original bid was prepared. By comparing actual performance with estimated time schedules, Production Control can set up either more rigid or more flexible schedules of operation for future production of the part.

Conclusions

It would be a tremendous stride for the reinforced plastics industry if standards could be established so that a definite, consistent margin of profit could be realized by a fabricator when quoting on an item. Too often in this new industry a job is underbid in order to obtain the contract. In the haste to acquire a contract, little or no consideration is often given to materials (which do fluctuate in price and supply), labor, and machine costs (including allowance for operational break-downs).

Some reinforced plastic firms are learning through bitter experience that much time and effort are necessary for making a proper quotation. While the costs of this time and effort in assembling and preparing the project for an actual production run are high, proper cost analysis and quotations will not only give the fabricator a reasonable profit margin once the job is under way, but ensure smoother production runs because many troubles have been anticipated.

It is important to repeat that an accurate and detailed investigation of every phase of plant operation must be considered in the proper cost analysis of a prospective job. This is essential in every industry, but is even more critical in the young and rapidly growing reinforced plastics field.

—THE END

Zytel and Teflon Resins as Bearing Materials—Part II

(Continued from page 319)

Summary and Conclusions

Both Zytel nylon resin and Teflon tetrafluoroethylene resin are being used extensively as bearing materials. Most of these applications have been developed independently and no attempt has been made to collect performance data in order to put future design on a firm basis.

Some of the compositions available and the properties of both Teflon and Zytel have been discussed. The properties of these materials and their behavior under little or no lubrication makes them interesting bearing materials for many applications.

Typical data on dry or partially lubricated bearings have been collected from a variety of sources. Work in our laboratories on lubricated bearings made of "Zytel" are reported for the first time. In addition, physical properties of these materials are described. With these properties and the bearing work done to date, it is believed that the selection of the material and the design of bearings can be done with greater accuracy.

The performance of Zytel with lubricant present was most surprising. High loads at medium to high speeds can be supported by what appears to be hydrodynamic lubrication even though little lubricant is present. This opens an entirely new field of applications for bearings made of this engineering material.

We have investigated the effects of wall thickness and clearance, but not those of other design parameters. This we plan to do. Additional data will be required in order to design bearings for some commercial applications. Our data have been presented with the thought that it can be applied directly to some bearing applications, and will help in guiding test programs on other applications outside the range discussed in this paper.

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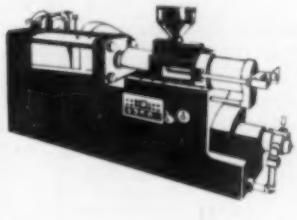
—THE END



Seventh National Plastic Exposition

The Seventh National Plastics Exposition, sponsored by the Society of the Plastics Industry, Inc., will be held in the New York City Coliseum on June 11-15. Returning to New York City on the tenth anniversary of its founding year, the Exposition will be one of the first shows to be held in the newly-constructed Coliseum. The biennial show is firmly established as a functional institution of the plastics industry, and this Exposition is expected to attract a record-breaking attendance of more than 20,000 representatives from industry, business, retailing, government, and education.

The show, which is not open to the general public, will feature the exhibits of more than 220 companies, both domestic and foreign, covering the gamut of materials, processes, equipment, machinery, products, and services used by the plastics industry. The Exposition, open daily from 12:00-6:00 p.m., covers two floors of the Coliseum comprising 273,000 square feet of air-conditioned exhibit space. The floors are connected by escalators, and there is off-street parking in the Coliseum basement for visitors' cars.

Arrangements for the show were handled by a 32-man committee, headed by W. C. Conroy, Erie Resistor Corp. Clapp & Poliak, Inc., is the Exposition management.

To assist our readers in planning their visit to the Exposition, PLASTICS TECHNOLOGY prints a special section in this issue. This section includes a statement by the Exposition chairman, Mr. Conroy; floor plans of the exhibit areas; an alphabetic list of the exhibitors; a classified list of exhibits to be shown; and a preliminary program of the SPI Annual Conference to be held during the mornings of June 11-15 at the Commodore Hotel.

PLASTICS TECHNOLOGY will occupy Exhibit Booth #313 at the show. This booth will be staffed by members of our editorial and business departments who invite you to stop in, make their acquaintance, and discuss any suggestions you can offer to further increase the interest and value of our magazine. We'll be looking forward to meeting you!

Importance of the National Plastics Exposition

WILLIAM C. CONROY
Sales Manager, Erie Resistor Corp.,
Chairman, Seventh National Plastics Exposition Committee

Today, we are witnessing an industrial revolution. Automation has become a byword. The age of commercial jet aviation is only a year away, and atomic power has placed us on the threshold of a new world whose wonders are yet to be revealed.

We are riding the crest of a thriving boom. New production records are being set. Many millions are being invested in research to improve present products and to introduce new ones in order to maintain the momentum. And the financial markets of Wall Street are reflecting the increased earnings of our corporations.

The plastics industry has been no laggard in its contribution to these increasing prospects. Plastic is the button on your coat, the pen you write with, the telephone in your home or office, your radio cabinet, the steering wheel you hold in your car. In fact, there is no phase in your daily living in which you do not come in close contact with myriads of plastic products.

Plastics material consumption in 1955 exceeded the most optimistic forecast. New materials have been given to us; new machines are being conceived and produced by our machinery and equipment suppliers; and new methods and techniques are flowing from the fertile minds of our engineers in companies both large and small.

These materials, these machines, and these modern methods are available for you to see at our Seventh National Plastics Exposition.

It is indeed fitting that this dynamic young industry will proudly present its accomplishments in the most up-to-date exposition building in the United States today —the brand new Coliseum in New York City.

In this fast-changing competitive age we live in, it is the company and the individual with knowledge who forge ahead.

For the buyer, the engineer, and the designer, a visit to the Seventh National Plastics Exposition is a must, for here will be displayed new materials, new applications, and new methods that are literally "shaping tomorrow's products."

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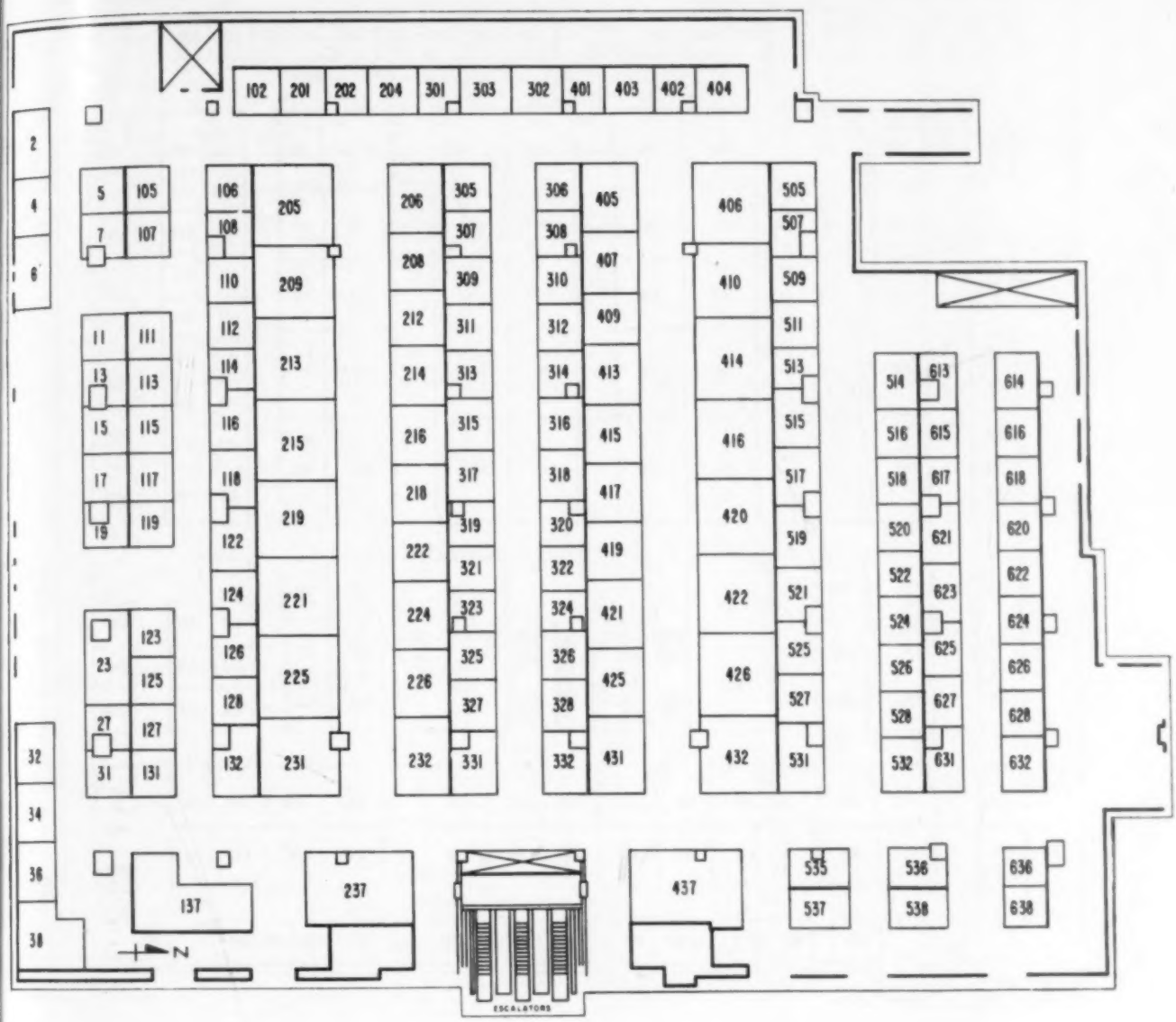
First Floor of Exhibit Area



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A & S Steel Rule Die	536
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American Welded Tank & Machinery Corp.	308
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Anchor Plastics Co., Inc.	327
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The Auto-Vac Co.	1142
Automatic Molding Machine Co.	1110
Avery Adhesive Label Corp.	102, 201
B. I. P. Engineering, Ltd.	1030
Bakelite Company, Div. of Union Carbide & Carbon Corp.	809, 813, 817, 825
Baker Brothers, Inc.	719, 721
Ball & Jewell, Inc.	725
Balsa Ecuador Lumber Co.	1219
Barber-Colman Co., Wheelco Instruments Division	1106, 1108
Barrett Division Allied Chemical & Dye Corp.	1029, 1035
Bassons Industries Corp.	636, 638
Belding Corticelli Industries	505
Bigelow Fiber Glass Products Div., Bigelow-Sanford Carpet Co., Inc.	942
B. Blacher	323
The Borden Co., Chemical Division	413, 415
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Cadillac Plastic & Chemical Co.	404
Camin Laboratories, Inc.	1217
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Consolidated Vaccum, Div. of Consolidated Electrodynamics Corp.	706
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Dake Corp.	1109
Danielson Mfg. Co.	204
Joseph Davis Plastics Co.	1112
E. F. Decor, Inc.	27
Detroit Mold Engineering Co.	839
Devoe & Raynolds Co., Jones Dabney Division	1117
C. H. Dexter & Sons, Inc.	314
The Dow Chemical Co.	1017, 1025
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Doven Machine & Engineering, Inc.	1141
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Durable Formed Products, Inc.	1118
Durez Plastics Div., Hooker Electrochemical Co.	514, 516, 518, 520, 522, 524

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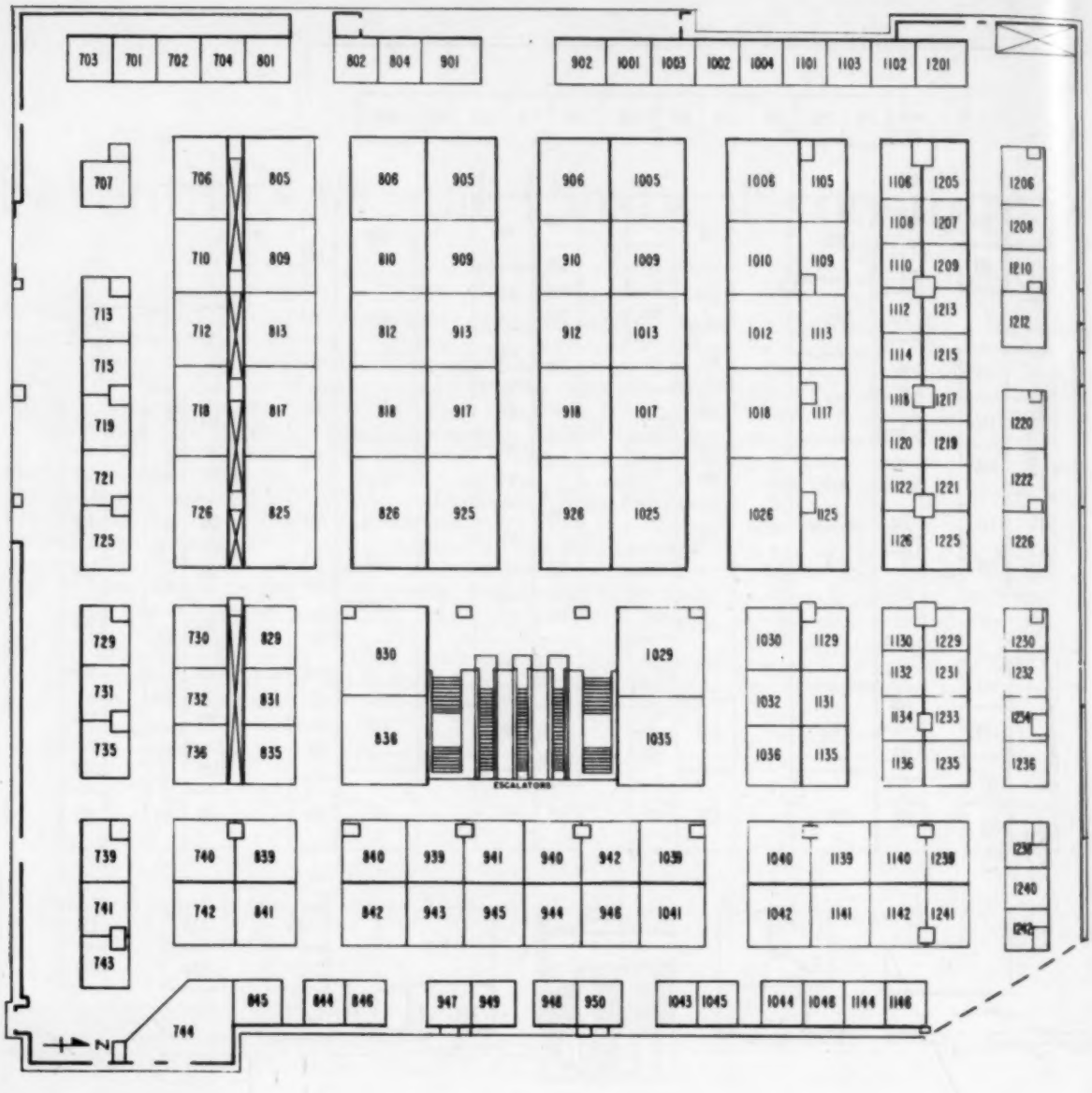
Second Floor of Exhibit Area



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H. Kohnstamm & Co., Inc.	1
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Lafayette Saw & Knife Co.	1
W. T. LaRose & Associates, Inc.	4
Lemmon & Snoap	1
Lester-Phoenix, Inc.	226, 2
Lewis Welding & Engineering Corp.	7
Lincoln Plastics Corp.	1
Logan Engineering Co.	1231, 1
Macbeth Corp.	7
Markem Machine Co.	1
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Typical Physical Properties of Forticel

Flow temperature:		
(°C.) (A.S.T.M.)	D569-48	167—178
Specific gravity:	D176-42T	1.18—1.21
Tensile properties:		
Yield (p.s.i.)	D638-52T	3380—5020
Break (p.s.i.)	D638-52T	3470—5240
Elongation (%)	D638-52T	56—66
Flexural properties:		
Flexural strength (p.s.i. at break)	D790-49T	6400—8500
Flexural modulus (10^5 p.s.i.)	D790-49T	0.23—0.30
Rockwell Hardness:		
(R scale)	D785-51	62—94
Izod Impact:		
(ft. lb./in. notch)	D256-43T	2.7—11.0
Heat distortion:		
(°C.)	D648-45T	59—70
Water absorption:		
% Sol. lost	D570-42	0.00—0.08
% Moisture gain	D570-42	1.5—1.8
% Water absorption	D570-42	1.6—1.8

Celanese Corporation of America, Plastics Division,
Dept. 184-E, 290 Ferry Street, Newark 5, N. J.

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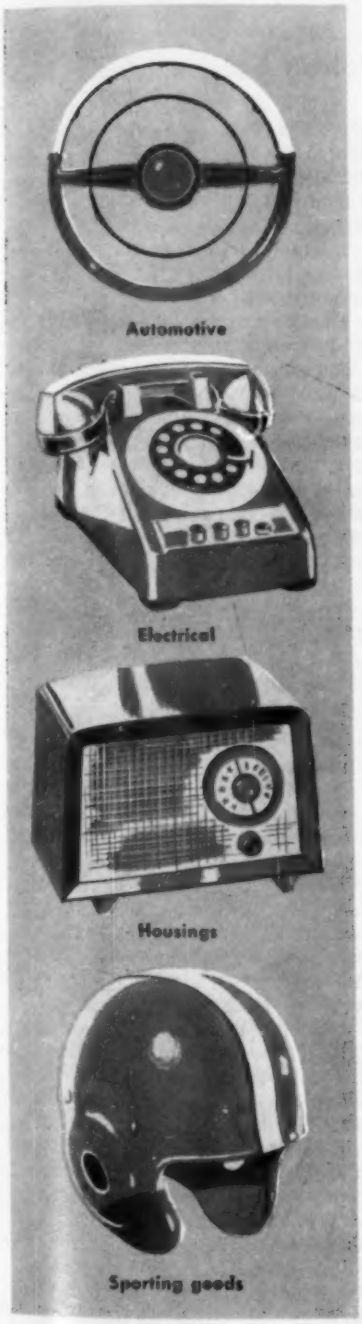

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Today, America's most popular fountain pens and mechanical pencils are being made of Forticel. And this has happened within months of the introduction of this brilliant, new Celanese Plastic!

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Consider these Forticel advantages as the penmakers do:

- **Durable Surface Lustre**
- **Brilliant Molded Finish**
- **Wide Color Range**
- **Dimensional Stability**
- **Form Retention**
- **Superior Toughness**
- **Good Weatherability**
- **Superior Moldability**
- **Machinability Without Cracking or Crazing**
- **Freedom From Objectionable Odor**

Forticel combines in a single material perhaps the best balance of properties of any thermoplastic. What the penmakers have discovered it can do for their precision products, is indicative of what it can contribute to product improvement in a variety of fields: automotive, electrical, personal items, toys and sporting goods.

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News of the Societies

SPI 1956 Annual Conference

The 1956 Annual Conference of the Society of the Plastics Industry, Inc., will be held in the Commodore Hotel, New York, N. Y., on June 11-15. Although the Conference is being held during the same days as the National Plastics Exposition, all sessions are in the mornings to avoid any real conflict with Exposition hours (12-6 p.m.). The preliminary program for the Conference is as follows:

Monday, June 11

Starting at 10:00 a.m., there will be concurrent sessions of the SPI Cellular Plastics and Sheet Forming Divisions. These meetings will take place in the East and West Ballrooms, respectively. The Cellular Plastics Division meeting will be devoted to the use of cellular plastics in transportation.

Tuesday, June 12

The session, scheduled to start at 9:30 a.m., will begin with a general introductory address on "Plastics Shaping Tomorrow's Products." This will be followed by keynote speakers on the automotive, refrigeration and air conditioning, packaging, building materials, and communications industries. A surprise finale, "Plastic Shapes on Parade," will conclude the session.

Wednesday, June 13

Three concurrent sessions will be held from 9:30-11:30 a.m. on plastics in automotive, packaging, and building materials applications. The automotive session, in the Grand Ballroom, will cover pre-mix molding, advances in body manufacturing techniques, automotive components, and automotive design. The packaging session, in the East Ballroom, will cover developments in film, rigid plastics, and protective coatings; packaging design; and a progress report on FDA legislation. The building materials session will be devoted to developments in structural and decorative applications, and building code problems.

These technical sessions will be followed at 12:30 p.m. by the SPI annual luncheon meeting which will feature the announcement of new officers of the Society, reports on SPI activities, and a report on FCC regulations.

Thursday, June 14

Two concurrent sessions will be held from 9:30-11:30 a.m.,; refrigeration and air conditioning applications (Grand Ballroom), and communications (West Ballroom). The refrigeration meeting will discuss such topics as vacuum forming, moldings, foam insulations, ducting, and design. The communications session will deal with the topics of vacuum forming, moldings, extrusion, printed circuits, and encapsulation and miniaturization.

A retail buyers' luncheon will be held at 12:30 p.m., and will feature the presentation of awards to winners in the API House Competition.

Friday, June 15

A management business symposium will be held from 9:30-11:30 a.m. The principal topic at this symposium will be "Sound Costing Practice."

In addition to the business and technical sessions, the Conference will include a reception on June 12 in the Grand Ballroom of the Commodore Hotel from 6:00-8:00 p.m., and a moonlight cruise up the Hudson River on the evening of June 14. A special program of entertainment has been planned for the ladies, including a daily hospitality suite staffed by members of the New York Convention Bureau.

Arrangements for the Conference are being handled by a 29-man committee, with Walter J. A. Connor, American Plastics Corp., as general chairman; E. R. Nepkie, Dow Chemical Co., as program chairman; John C. Sack, E. I. du Pont de Nemours & Co., Inc., as entertainment chairman; and H. D. Cooper, Koppers Co., Inc., as housing chairman.

Midwest Plastic Fair

The SPE Upper Midwest Section is sponsoring a Plastic Fair during the afternoon and evening of May 21 in the Arizona Room of the Prom Ballroom, St. Paul, Minn. The Fair is designed to give all people engaged in the plastics industry an opportunity to become acquainted with other plastics activities in the Midwest. Representatives from more than 100 plastics and allied industry firms are expected to attend the affair which will feature displays of products and the exchange of ideas. A banquet will be held in the evening, featuring a talk by Brooks Stevens, industrial designer.

Discuss Injection Molding

The March 13 meeting of the SPE Milwaukee Section was highlighted by two talks; G. B. Thayer, Dow Chemical Co., spoke on "Injection Molding," and Joseph Eveland, also of Dow, discussed the market potential for polystyrene.

Using two films to illustrate his talk, Mr. Thayer discussed the injection molding of polystyrene and polyethylene. High-speed injection was said to produce the most desirable products and, in conjunction with hot molds, gave the best results with products containing inserts. In his talk, Mr. Eveland described some of the improved styrene polymers and copolymers under development. These new polymers show better flow properties, physical properties, and heat resistance, while the new copolymers also show improvements in properties and in transparency.

Toledo Section Meets

A talk on "Automatic Molding" by O. M. White, F. J. Stokes Machine Co., highlighted the February 15 dinner meeting of the SPE Toledo Section, held at Harrison's Ranch House Restaurant with 37 members and guests in attendance. Mr. White's talk was similar to his article which appeared in the October 1955 issue of PLASTICS TECHNOLOGY.

The audience was impressed by actual production figures given by the speaker which showed 10-20% higher production on a 24-hour day with automatic equipment, even when used at slower cycles, in comparison with semi-automatic press operation. Particular interest was displayed by local injection molders in the fact that Stokes' automatic molding machines have a stripping comb operated independently by hydraulic ejectors.

Joint Dinner Meeting

The March 15 dinner meeting of the SPE Eastern New England Section was held jointly with the SPE Rhode Island and Southeast Massachusetts Section and the Boston-Providence Chapter of SPI. Some 130 members and guests of the three groups attended the meeting which took place at the Lafayette House, Foxboro, Mass.

Two talks were presented at the technical session; V. S. Bowers, E. I. du Pont de Nemours & Co., spoke on the design properties of Zytel nylon resins, while Sanford S. Zimmerman, Vacuum Forming Corp., discussed the vacuum forming process and its future potentials. Mr. Bowers used slides to illustrate his talk which covered such properties of Zytel as modulus of elasticity, moisture content, dimensional stability, deformation under stresses, and tensile-time relationship. Mr. Zimmerman's talk described the advantages and disadvantages of vacuum forming, especially in comparison to injection molding.

A showing of the Bakelite Co. film, "Molding of Phenolics," followed the presentation of the two talks.

Discuss Plastics Decorating

The SPE Kentuckiana Section held a regular dinner meeting on March 21 at Bauer's Restaurant, Louisville, Ky., with approximately 30 members and guests in attendance. Speaker of the evening was J. A. Self, Logo, Inc., who discussed "The Decoration of Plastics." Mr. Self's talk covered lacquer and paint formulations for plastics use, the functions of the various ingredients in the formulations, film properties, film defects, and defects which may be encountered in a vacuum metalized film. The talk was illustrated by slides and typical decorated parts.

The talk was preceded by a brief business session at which reports were given by the various committee chairmen. Plans were discussed for the presentation of the group's Achievement Award at the May meeting to the member deemed to have made the most outstanding contribution to the plastics industry during the past year.

Talk on Polyurethanes

The future role of polyurethanes was the subject of a talk given by E. M. Fettes, Thiokol Chemical Corp., at a luncheon meeting on March 21 of the New York Section, American Institute of Chemical Engineers.

Mr. Fettes surveyed the development and present applications of polyurethanes, and discussed possible areas of future application and anticipated trends in chemical raw material requirements for polyurethane manufacture. More than 100 companies were said to be engaged at the present time in some phase of this rapidly growing field, which offers such diverse outlets as structural members, coatings, tires, flexible foams, insulations, and acoustical materials. The speaker also showed a Du Pont film demonstrating the application of a foamed polyurethane by direct spraying to serve as an insulation on chemical storage tanks.

Two Speakers at Newark

Approximately 85 members and guests of the SPE Newark Section attended the regular dinner meeting on April 11 at the Military Park Hotel. Two talks were given at the technical session: "Accessory Equipment Required to Injection Mold Quality Parts," by W. E. Rahm, consulting engineer; and "Use and Application of Isocyanate Foams," by B. S. Collins, Nopco Chemical Co.

Mr. Rahm began his talk with some reminiscences on the beginning of the injection molding industry. In speaking of accessory equipment needed to make high quality injection molded parts, he emphasized the importance of drying equipment to control moisture content, and the need for separate drying of different plastics. Other accessories discussed were mold temperature controllers, instrumentation, granulators and chunk cutters, screening of reground material, weigh feeders, hopper loaders, degating tools, annealing bath for nylon, X-ray inspection of molded parts, and push-on mold fittings.

Mr. Collins noted that Nopco has been licensed to make isocyanate foams by the three leading domestic companies in the field—Lockheed, Monsanto, and Du Pont—and that all three systems can produce both rigid and flexible foams. Lockheed's is a two-component system, using an alkyd resin and isocyanate mixed in a 50:50 ratio. Du Pont's system also is two-component, using a pre-polymer (resin and isocyanate pre-mixed) and catalyst mixed in a 90:10 ratio. The Mobay system is a multi-component one.

The speaker gave the advantages of Lockheed foams over Du Pont foams as being higher strength, greater hardness, higher heat distortion (350° F. vs. 150° F.), and lower shrinkage. Du Pont foams have the advantages of lower cost, shorter post-curing, and less pressure and heat produced during foaming. While the reaction is exothermic under both systems, the Lockheed foam is of closed-cell structure while the Du Pont foam structure is partially open.

Mr. Collins illustrated his talk by showing a film of foam making both in the laboratory and on a commercial basis, by an extensive display of foams and foamed structures, and a demonstration of foam making. In discussing the displays, he noted that the industry lacks proper mechanization of the fabrication process, but that this handicap is expected to be overcome in the near future.

The meeting closed with the distribution of door prizes contributed by Prodex Corp. and Norman Bragar Co.

Plastic Tooling Research

An intensive research program on "Properties of Plastics Used for Tooling Applications" has been initiated by the American Society of Tool Engineers' Research Fund. A $10,000 contract has been awarded to the Purdue Research Foundation, and the work will be carried on under the direction of Prof. O. D. Lascoe. Cosponsors of the project are Bakelite Co., Shell Chemical Corp., Ciba Co., Inc., and Marbletter Corp.

The Foundation will conduct a study of four variables in two six-month phases. The first phase involves a complete survey of existing literature and visits to plastic tooling plant, and the compiling of a report summarizing tested engineering data. The second phase will comprise the establishment of standard test methods for measuring and predicting reactions of the variables involved (shrinkage characteristics, abrasion resistance, heat resistance, and physical properties essential for tooling).

Additional studies will be made in each case to determine the specific results which may be expected when any one of the variables is changed. The final findings will be compiled into a basic manual for tool engineers involved in plastic tooling.

Hydraulic System Maintenance

A panel discussion on "Hydraulic System Maintenance" featured the March 27 joint meeting of the SPE-SPI Philadelphia Sections, held at the Franklin Institute. The panel consisted of three representatives from an equipment supplier, an oil company, and a plastics molder.

The first speaker, G. C. Bonnell, Vickers, Inc., described some of the changes that have taken place in hydraulic equipment to facilitate maintenance and repair. In discussing some of the problems with hydraulic systems that occur in service, he noted that the major problem was air in the system, and that such air was frequently the result of oil foaming.

The selection and properties of hydraulic fluids for use in plastics molding presses was the topic covered by the second speaker, R. Q. Sharpe, Socony Mobil Oil Co., Inc. He noted that standard oxidation tests of the fluids frequently do not correlate with results in actual service. Three new types of fire-resistant fluids were described, together with the problems encountered during their development.

The final speaker, Gene Quear, Delco Remy Div., General Motors Corp., presented the topic from the user's viewpoint. He discussed cases where poor maintenance had resulted in large economic losses, and stressed the need for proper maintenance procedures and the use of maintenance records.

Features Two-Part Program

Inclement weather limited the attendance at the March 21 meeting of SPE's New York Section to 65 members and guests; however an interesting, two-part program was presented. Benjamin H. Wasserstrom, tax consultant, discussed "Planning for Income Tax Economies," summarizing tax considerations in relation to business and personal income problems. He pointed out that company owners have to think in terms of "after-tax" dollars. High compensation is not the answer, rather a combination of fringe benefits such as cash discounts, free or below-cost lunches, itemized vouchers instead of straight allowance on expense accounts, company insurance, stock options, and stock bonuses. Deferred compensation and profit sharing are also worth looking into, since they become capital gains on retirement.

"Polyliner, Injection Cylinder Liner," was described by Richard H. Hardesty, E. I. du Pont de Nemours & Co., Inc. This fluted, perforated sleeve fits inside the cylinder and, due to its unique construction, absorbs heat so effectively that the inner surface of the liner approaches that of the cylinder wall. As the plastic melts, it flows through the perforations toward the nozzle. Advantages claimed for the liner are lower resistance to flow, greater plasticizing capacity, and more uniform melt temperature.

NEWS of the INDUSTRY

Styrene Wall Tile Discussed

About 200-million square feet of plastic wall tile will be bought for residential use in 1960. The prediction, a 50% increase over 1954 sales, was the finding of a market and consumer survey made by Dun & Bradstreet, and presented at an all-day meeting of some 50 molders and other representatives of the styrene wall tile industry on March 6 at the Hotel Cleveland. Cleveland, O. The meeting was sponsored by the plastics division of Monsanto Chemical Co., Springfield, Mass.

The prediction pointed out that this sales increase of wall tile will take place only if improved design and workmanship are coupled with more effective marketing. Monsanto also showed the attendance a portfolio of unique "Modern Mosaic" wall tile designs; a motion picture for training professional tile installers; and several rooms illustrating the versatility and style of the new wall tile shapes. The new designs, which make maximum use of plastic's inherent formability and color, were created at the design laboratory of Pratt Institute under Monsanto's sponsorship.

Expands Cellophane Capacity

American Viscose Corp., Philadelphia, Pa., has announced plans for expanding its annual cellophane production by 50-million pounds. The additional output will be produced at the firm's Marcus Hook, Pa., plant which manufactured rayon textile yarns until recently.

American Viscose currently produces 100-million pounds of cellophane at its plant in Fredericksburg, Va.; however, present production has proved inadequate to meet current demands. The Marcus Hook facilities will be converted and modernized to expedite the new operation.

Ace Plastic Expands Plant

The addition of 25,000 square feet of space to the extrusion department of Ace Plastic Co., Jamaica, N. Y., has brought the company's total plant area to 75,000 square feet. The additional area permits Ace to better service its customers with the company's line of standard plastic rods, tubes, and shapes, and to expand its production, development, and research work on custom extrusion of plastics for industry.

To Expand Geon Resins Plant

An expansion program for its Avon Lake, O., plant manufacturing Geon vinyl resins and compounds has been announced by B. F. Goodrich Chemical Co., Cleveland, O. The expansion is expected to cost $8-million, and be completed by next March. Work on the new additions will commence early this June. In addition to expanding Geon producing facilities, the program calls for the construction of a new boiler plant, and some additions to the development laboratories.

When completed, the new facilities will almost double Avon Lake's present vinyl resin output, according to John R. Hoover, company president. Girdler Co. will act as general contractor for the expansion, building according to Goodrich Chemical's basic design specifications and engineering supervision. Architectural work for the new buildings will be done by Dalton & Dalton Associates.

Doubling Hetron Capacity

A plant expansion to double the capacity of its Hetron polyester resin manufacturing facilities is in process at Hooker Electrochemical Co., Niagara Falls, N. Y., and is expected to be completed by June 1. The demand for the company's line of eight Hetron resins has risen rapidly, indicating that current capacity of the present multi-million pound per year plant will be inadequate to meet fabricators' demands for much longer.

New Plastics Company Formed

A new plastics company, Hastings Plastics, Inc., has been formed by Norry M. Hastings, former chief chemist and manager of product development for Rezolin, Inc. The new firm, located in Santa Monica, Calif., will manufacture and distribute a complete line of compounded resins and related materials for use in industrial applications in the electronics, low-pressure laminating, and plastic tooling industries. The company will have complete facilities for testing, compounding, manufacturing, and storing plastic materials. In charge of sales is Hobart G. Hobbs, previously sales manager for Thalco Glass Fibers, Inc., where he was actively engaged in the sale of reinforced plastics, polyester and epoxy resins, and reinforcing materials.

KEEP AHEAD of competition—find out how to benefit from what's latest and best in plastics. Come to the NATIONAL PLASTICS EXPOSITION, June 11-15, New York Coliseum. See . . . feel . . . hear about new materials, new uses, new equipment. Write for tickets now. Use your company letterhead, please—general public won't be admitted
Plastics
shaping tomorrow's products
at the new New York Coliseum
7th National Plastics Exposition
sponsored by:
The Society of the Plastics Industry, Inc., 250 Park Avenue, New York, N. Y.

Plastics Design Contests

Two concurrent design contests for applications of thermoplastic rods and tubes have been announced by Cadillac Plastic & Chemical Co., Detroit, Mich. One is an open contest restricted to product designs already in production or in tooling by December 1, while the other contest is for students. First prize in the open contest is $1,000, and second prizes of $150 each are offered in each of the following three categories: consumer products; industrial or technical products; and architectural or decorative products. The corresponding prizes in the student contest are $250 and $75.

Entries can cover any usage of cast or extruded rod in any thermoplastic material, and the entry design remains the property of the submittant. Criteria for the awards will be aptness and interest of the application; problem-solving ingenuity; and understanding of the functional possibilities of the material involved. Entries, in the form of photos or sketches, may be submitted by individuals, design teams, companies, or school departments, and there is no limitation on the number of entries.

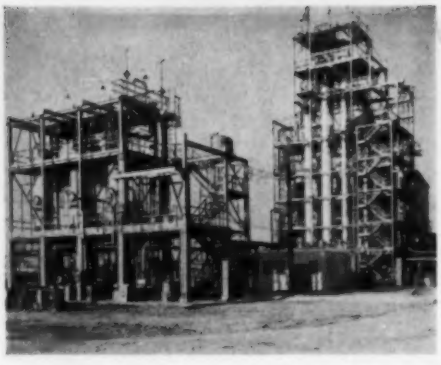
The deadline for entries is September 30. Full information and entry forms can be obtained from Ladd Orr, IDI, Contest Advisor, care of Cadillac Plastic & Chemical Co., 15111 Second, Detroit 3, Mich. Information also is available from the company's branch offices in Chicago, St. Louis, Los Angeles, and San Francisco. Prizes to the winners will be presented at a special meeting in New York City before February 1, 1957.

New Laminating Lab

A model decorative and industrial laminating laboratory is being installed at the application research facilities of the plastics division, Monsanto Chemical Co., Springfield, Mass. According to H. W. Mohrman, director of research for the division, the new lab is part of an increased program to perfect and develop uses for the company's melamine and phenolic laminating resins. An experimental lab treating unit will be the nucleus of the new equipment, which is expected to be in operation by late summer.

New Polyethylene Facilities

New production facilities are being designed by Girdler Co., Louisville, Ky., for the Texas Eastman Co., a division of Eastman Kodak Co., at Longview, Tex. Girdler's contract includes engineering and procurement of equipment and materials. The new facilities, which will substantially increase Texas Eastman's output of Tenite polyethylene, are scheduled for completion later this year.



Airco's new vinyl acetate monomer plant, Calvert City, Ky., showing (left) acetylene purification unit and (right rear) distillation and reaction units.

New Airco Plant in Operation

The new vinyl acetate monomer plant at Calvert City, Ky., for Air Reduction Chemical Co., New York, N. Y., is in commercial operation. Built for Airco by Lummus Co., the new installation has an annual productive capacity of 30-million pounds of the monomer. Built at a cost of more than $3-million, the plant is of outdoor construction throughout, with many process vessels fabricated of stainless steel and aluminum alloys. Process control is centralized in a modern control room.

The plant occupies an area of 550 by 800 feet, with the highest point being 125 feet above grade. Nation-wide distribution of the monomer will be made chiefly by railroad tank car, while storage facilities are maintained at Paulsboro, N. J., for convenient shipment by tank truck and drums to northeastern customers. The monomer is being produced in two grades, fully and partially inhibited against homopolymerization during transit or storage.

Management personnel for the new plant include O. W. Fortner, manager; J. W. Frevert, superintendent; and R. W. Rollins, office manager.

Melamine Dinnerware Promotion

A group brand name promotion program, said to be the largest in the history of the melamine dinnerware industry, is being sponsored by Barrett Division, Allied Chemical & Dye Corp., New York, N.Y., a supplier of melamine molding compound. According to Carleton Ellis, Jr., director of plastics and resins sales for Barrett, all 10 of the country's largest melamine dinnerware producers will participate in the program.

The program will be launched with a series of magazine ads in May, featuring the brand names of the 10 producing companies, followed by point-of-sale merchandising helps distributed by the participating firms. The participating companies are Boonton Molding Co.; International Molded Plastics, Inc.; P. R. Mallory Plastics, Inc.; Hellmick Mfg. Co.; Prolon Plastics Div., Pro-phy-lac-tic Brush Co.; Kenro Corp.; Watertown Mfg. Co.; Northern Industrial Chemical Co.; Spaulding Industries, Inc.; and Plastics Mfg. Co.

Tee-Pak to Build New Plant

Tee-Pak, Inc., Chicago, Ill., will build a multi-million dollar branch plant for cellulose casings and plastic packaging materials for meats and food products in Danville, Ill. Ground will be broken on a 36-acre tract for the approximately 200,000-square foot plant in July, with completion scheduled for next year.

The main factory building will be primarily a one-story structure, with certain areas being two and three stories high. A complete line operation will be employed, and material handling will be virtually fully automatic. A single-story wing will house offices, employee locker rooms, first-aid room, and cafeteria.

Cutting of Urethane Foams

An economical means of making profile cutting from solid slabs of urethane foam with "hot wire cutting" has been developed by Nopco Chemical Co., Harrison, N. J., which has been using the method experimentally for the past several months. By use of this technique, urethane foam padding can be profile-cut in one piece and in one operation to fit any size or shape. Backs and sides for molded form chairs and seat cushions have been cut successfully by the company.

Nopco also has experimented successfully with a mattress composed of urethane foam slabs adhered together so as to provide a coring effect. Varying degrees of resiliency and flexibility to conform to body weight variations from head to foot can be achieved by simply varying the profile. The Nopco cutting technique involves the use of a relatively inexpensive cutting machine. Although still in the experimental stage, this machine is expected to be generally available in the near future.

Borden Buys Tubing Firm

Borden Co., New York, N. Y., has purchased Resin Industries, Santa Barbara, Calif. The acquisition includes the consolidated activities of Resin Industries, Resinite Sales Corp., and Grant Chemical Co., all of Santa Barbara. Resin Industries makes vinyl insulation tubing and sleeving, vinyl and polyethylene medical tubing, garden and agricultural hose, flexible sprinklers, and irrigation tubing, while Grant manufactures molding compounds and special vinyl extrusion compounds.

Resin Industries will be operated as a wholly-owned subsidiary of Borden, with no changes in management or personnel; G. C. Ehrlich, founder of the company, will continue as head of the consolidated organization. Under the new set-up, Resin Industries becomes Borden's fourth West Coast plant.

Silk Screening Service

The availability on a national basis of its silk screening department for the preparation of screens for printed circuits has been announced by Naz-Dar Co., Chicago, Ill. Company technicians will perform all phases of preparing the screens from customer schematics. A patented method of stretching the silk on the frame insures tautness and will eliminate any circuit distortion during the length of the production run. All framing is extra rigid to withstand the rough handling of production schedules. The company guarantees the exactness of the reproduction of the circuit on the screen from the schematics. Naz-Dar has been performing a similar service in the general silk screen printing field since 1922.

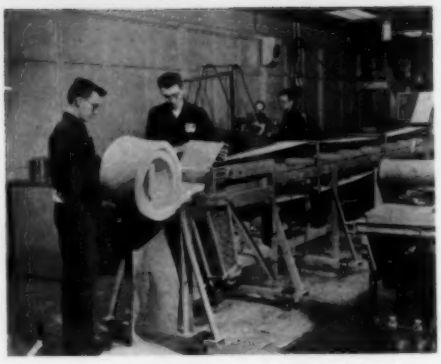
Reichhold-Catalin Merger

Plans for merging Reichhold Chemicals, Inc., White Plains, N. Y., into Catalin Corp. of America, New York, N. Y., have been announced jointly by Henry H. Reichhold, chairman of the former company's executive committee, and Harry Krehbiel, Catalin president. The merger agreement has been executed by both boards of directors, subject to the approval of the stockholders of the two firms.

Upon merging, stockholders of Reichhold will receive 2.8 shares of the common stock of the merged company for each R.C.I. share, while Catalin stockholders will retain their holdings. A substantial amount of the stock to be received by the Reichhold stockholders on exchange will be placed in a voting trust. The name of the merged corporation will be Reichhold-Catalin Industries, Inc.

To Construct New Plant

Construction of a new plant at Ste. Therese, Que., is under way by Canadian Resins & Chemicals, Ltd., Montreal, for the manufacture of polyethylene films and layflat tubing. When completed, the plant will contain three production lines for the manufacture and treating (for printability) of polyethylene film. Full production is expected in six months' time, and initial limited production will be made available in May. The techniques and equipment to be utilized in the plant are designed to produce materials having the necessary qualities to meet the complete needs of Canada's industrial and packaging film industries.



Continuous urethane foam slab unit in Du Pont elastomers lab.

Du Pont Opens Elastomers Lab

A $2,800,000 product development and technical service laboratory was officially opened on April 19 by the elastomers division of E. I. du Pont de Nemours & Co., Inc., at Chestnut Run, near Wilmington, Del. Made necessary by the firm's expanded business in the field of rubber and plastic elastomers, the new unit is probably the largest and most complete unit of its kind ever assembled.

Designed primarily to provide technical service on neoprene, Hypalon chlorosulfonated polyethylene, Hylene organic isocyanates, and rubber chemicals, it duplicates most production operations on a pilot-plant scale. Separate laboratory areas are provided for isocyanate work, adhesives, paper, dry-polymer processing, latex, wire-coating, physical testing, and consumer-product testing.

Indicative of its scope, the laboratory is equipped to manufacture urethane tire treads, apply them to tire carcasses, cure them, and test the finished tires for strength of the adhesive bond. It has an experimental unit for the continuous manufacture of urethane foams, and a pilot installation for continuous extrusion of electrical wire coverings. Other areas include a mill room, colors laboratory, and a calendering set-up.

The new laboratory is a two-story steel and masonry structure, with brick exterior in general conformity with the other Chestnut Run facilities. The various laboratories are located about five miles from Du Pont's Experimental Station, which is dedicated to fundamental and long-range research.

Monsanto Forms New Division

The formation of a new division, Domestic Subsidiaries & Affiliates Division, has been announced by Monsanto Chemical Co., St. Louis, Mo. The division will administer Monsanto's interest in Shawinigan Resins Corp., Springfield, Mass.; The Chemstrand Corp., Decatur, Ala.; Mobay Chemical Co., also of St. Louis; and other companies affiliated with the parent firm. J. Russell Wilson, Monsanto vice president, has been named general manager of the new division.

In Brief . . .

The Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., has announced the publication of a monthly "Technical Digests," which will carry translations and digests from European technical and industrial journals. The digest is published by the Organization for European Economic Cooperation, a multi-government agency set up to stimulate economic growth of member-nations.

Dow Chemical Co., Midland, Mich., has opened a new office in Camden, N. J., replacing the office formerly maintained in Philadelphia. Located at 400 Market St., the office is expected to provide better servicing of the six-state surrounding area.

Cadillac Plastic & Chemical Co., Detroit, Mich., has been appointed distributor for Celanese Corp.'s Marco polyester resins and for Bakelite Co.'s Krene vinyl materials. Cadillac services some 20,000 active accounts.

Carbide & Carbon Chemicals Co., New York, N. Y., has announced a price reduction averaging 44¢ per pound for drum and tank-car lots of 2-methyl 5-ethyl pyridine. The material is used as an extraction solvent, a resin curing agent, and as an intermediate for corrosion inhibitors.

Haas Miller Corp., Philadelphia, Pa., has announced a change in corporate name to Harry Miller Corp. The firm is active in the industrial chemical and chemical products field.

Foam King, Inc., has announced the acquisition of a full-scale plant at 1816 Boston Road, Bronx, N. Y. Manufacturer of a basic plastisol for use by licensees of the Foam King process of making vinyl foam, the company also maintains its own fabrication operations. Previous address was 405 Bacon St., Bronx, N. Y.

Mannesmann A. G., of Germany, is understood to have a substantial interest in the Societe Generale des Produits Plastiques, recently formed in Luxembourg. This company, which is capitalized at 2,000,000 francs, proposes to buy, manufacture, and sell different plastic materials. A large part of the equipment is reportedly to be supplied by the Societe Mapre of Diekirch which apparently has been acquired by Mannesmann as ex-enemy property.

B. F. Goodrich's plastic products department, Marietta, O., has announced the addition of three new Koroseal upholstery patterns: Damasque, Siamese, and Glitter.

Escambia Bay Chemical Corp., Pensacola, Fla., has awarded a contract to construct a 30-million pound PVC plant on its Santa Rosa County, Fla., acreage. Scheduled for completion in the latter half of 1956, the new facility marks the firm's entry into the plastics raws material field.

Rohm & Haas Co., Philadelphia, Pa., has announced a 3-9½% reduction in the prices of its Plexiglas sheet and molding powders, and its methyl methacrylate monomer. The reductions are expected to enable acrylics to enter markets where price was formerly a barrier.

Joseph J. Smith, representative for Lester injection molding machines and Lester die casting machines in the Chicago area, has relocated his office to 5875 North Lincoln Ave., Chicago, Ill.

Chas. Pfizer & Co., Brooklyn, N. Y., has announced the acceptance of its Citroflex A-2 as a plasticizer for food-packaging films by three government agencies: Food & Drug Administration; Meat Inspection Branch, U. S. Department of Agriculture; and the Quartermaster Food & Container Institute.

Borden Co.'s chemical division, New York, N. Y., has combined its monomer and polyco departments to form the Polyco-Monomer department. E. J. Sullivan, general manager of the resins & chemicals department, will head the new operation.

Eastman Chemical Products, Inc., Kingsport, Tenn., has announced a new bulk-shipment plant which delivers Tenite polyethylene directly into the customer's storage bins. This service saves handling costs for the customer, and reduces the amount of floor space needed for storage. The shipments are made by truck in air-tight compartments, and the pellets are unloaded through a delivery line and directly into the storage bins by means of self-contained pneumatic facilities in the shipping truck. The bulk-shipment service is available to customers in Minnesota, Arkansas, Texas, and all states east of the Mississippi, except for Florida where service is limited to Miami.

Furane Plastics, Inc., Los Angeles, Calif., has appointed Permacel Tape Corp., New Brunswick, N.J., as national sales distributor for its Epocast electrical insulating resins. It is hoped, thereby, that the materials will be more readily available to manufacturers of electrical and electronic equipment, aircraft manufacturers, missile manufacturers, and electrical repair services.

Escambia Bay Chemical Corp., Pensacola, Fla., dedicated its first multi-million dollar plant, which will supply an eight-state area in the Southeast with anhydrous ammonia and ammonium nitrate fertilizers. Located 20 miles north of Pensacola on Escambia Bay, the new unit was completed in a record eight-month period.

A. Z. Bogert Co., manufacturer of Acousti-Bond tile adhesives and flexible vinyl tile cove, has announced a change in address for its offices and plant, from Ambler, Pa., to larger quarters at nearby West Point, Pa.

M. W. Kellogg Co., has moved its main offices from 225 Broadway to 711 Third Ave., New York, N.Y. Pullman, Inc., Kellogg's parent company, also will have offices in the new building.

Acheson Dispersed Pigments Co., Philadelphia, Pa., has joined the other divisions and affiliates of Acheson Industries, Inc., in celebrating the 100th anniversary of the birth of Dr. Edward Goodrich Acheson. The occasion will be marked by review papers, newspaper and journal articles, and special museum exhibits. In addition, the story of Acheson's discovery of carborundum will be reenacted in a radio broadcast sponsored by the American Chemical Society.

Ohio-Apex Division, Food Machinery & Chemical Corp., Nitro, W. Va., now ships phosphorus compounds in special nickel-clad steel tank cars, constructed of 20% Lukens nickel-clad steel. Built by American Car & Foundry Co., Milton, Pa., the cars feature dome head and cover, safety vent base, washout chamber, and plug, all of nickel castings.

Carbide & Carbon Chemicals Co., New York, N. Y., has provided for the production of an additional 65-million pounds of ethylene glycol per year at its Seadrift, Texas plant. This extra capacity brings the total output of ethylene oxide in this plant to more than 200-million pounds yearly.

W. R. Grace & Co., New York, N.Y., and Farbwerke-Hoechst, A. G., Frankfurt/Main-Hoechst, Germany, have jointly announced plans to build a plant in Brazil for the production of low-pressure polyethylene. This will be another step in the plans of the two companies to develop a full line of essential chemicals to supply the needs of Brazilian industry.

Pantasote Co., New York, N. Y., has appointed the Tahoe Corp., also of New York City, as distributor for its lightweight plastic film in orders of 1,000 pounds or less. A wholly-owned subsidiary of Pantasote, Tahoe will stock all popular gages and colors to service the East, and will maintain a warehouse in Chicago for midwestern customers.

Chemonomics, Inc., New York, N.Y., has announced the availability of a translation of Belgian patent No. 538,782, issued to Karl Ziegler of Germany, and to Montecatini Co. of Italy. The patent describes a new catalytic technique for producing polypropylene; giving 31 examples, details of the catalyst, process conditions, and properties of the polymer produced.

Whitman Laboratories, Inc., Norwich, N.Y., has been formed to engage in the manufacture and sale of industrial chemicals. The firm will act as exclusive sales agent for Beech-Nut's vinyl acetate resins in the Midwest, West, and South; will serve as national broker for Sheffield Chemical's industrial caseins; and will represent Chemo Puro's industrial preservatives and chemicals.

Monsanto Chemicals (Australia), Ltd., is to erect a new research building at its main plant at West Footscray. The building, which is to have a total floor space of about 12,000 square feet, will house the research laboratories and staff, as well as the general and technical libraries.

Tech-Art Plastics Co., Morristown, N. J., has announced the installation of larger injection molding machines, and additional compression presses. The firm is engaged in custom molding of electrical, electronic, and appliance parts.

Pyramid Products, Inc., Cleveland, O., custom molders of thermoplastic parts, has appointed R. D. Cistone & Associates, 210 Heights-Rockefeller Building, Cleveland 18, O., as its national sales representative.

Precision Plastics Co., Philadelphia, Pa., has added 15,000 square feet to its manufacturing facilities, in the form of a modern, one-story factory structure. The new unit will house additional injection molding equipment and other manufacturing machinery.

Phillips Petroleum Co., Bartlesville, Okla., has licensed Societe des Usines Chimiques Rhone-Poulenc, Paris, France, to use the Phillips-developed process for making rigid polyethylene. The agreement grants the firm exclusive rights in France,

News from Abroad

Licensees for Elastomer Process

Seven major European companies have been licensed to use the Elastomer process in the production of vinyl foam, according to The Girdler Co., Louisville, Ky., exclusive licensor of the process in all foreign countries except Canada. The process, developed by Elastomer Chemical Corp., Newark, N. J., uses an inert gas, rather than a chemical blowing agent, to make vinyl foam.

The new licensees are as follows:

(1) Les Etablissements Marechal, Paris, France, manufacturers of vinyl-coated fabrics and unsupported vinyl films. This firm has placed an order with Girdler for a complete plant to make vinyl foam continuously in slab form.

(2) Le Laboureur, Roubaix, Wattrelos, France, makers of textiles, vinyl-coated fabrics, and vinyl films. This company has ordered the essential components of a plant for the continuous production of vinyl foam, including Girdler's Votator foaming apparatus and Thermex high-frequency equipment.

(3) Svenska Gummifabriks Aktiebolaget, Gislaved, Sweden, a major tire manufacturer in Sweden and makers of a variety of commodities. This company is making engineering and marketing studies to determine the type of plant it will build.

(4) Dunlop Rubber Co., Ltd., London, England, a major tire and rubber goods manufacturer and the world's largest processor of latex foam. The firm's Dunpillo Division, at Liverpool, will handle the manufacture of vinyl foam by the Elastomer process.

(5) Dunlopillo G.M.B.H., Hanau am Main, Germany, a division of Deutsche Dunlop Gummi Compagnie A.G., which is affiliated with Dunlop in England. This firm has not yet decided on what plant equipment will be obtained in the United States, but vinyl foam facilities will be installed in existing buildings at Hanau.

(6) British Geon, Ltd., London, England, a joint venture of Distillers, Ltd., of England, and B. F. Goodrich Chemical Co., Cleveland, O. Makers of PVC. The license is for experimental operations aimed at promoting Geon 121 for use in making vinyl foam. The company plans to install complete pilot plant facilities for vinyl foams.

(7) Elson & Robbins, Ltd., Long Eaton, Nottingham, England, makers of spring and upholstery products. The firm plans a complete plant for the continuous production of vinyl foam, using Votator and Thermex apparatus.

During 1956, Girdler expects to grant Elastomer process licenses to other European companies, and to firms in Mexico, South America, Australia, and Japan.

Monsanto Aids Spanish Firm

An agreement providing for acquisition of an equity interest in Etino-Quimica, S.A., Barcelona, Spain, in return for the investment of machinery, equipment, and technological aid by Monsanto Overseas, S.A., has been announced by the overseas division of Monsanto Chemical Co., St. Louis, Mo. Etino-Quimica presently has plant facilities at Monzon, Spain, for the production of PVC. The agreement with Monsanto provides for the expansion of these facilities, and the building of polystyrene production facilities. Work to accomplish both projects is already under way.

With the completion of the polystyrene units, Etino-Quimica will become the first producer of this plastic in Spain. Etino-Quimica was formed originally by Hidro-Nitro Espanola, S.A., an electrochemicals manufacturer, and Aiscondel, S.A., a Spanish molding and calendering firm.

Cold-Spray PVC Coatings

"Coating 310" is a film-forming material consisting of PVC to which special plasticizers have been added and which after curing yields a product having qualities identical with those of plasticized, extruded PVC. Developed by Plastiques de Saint-Denis, the new product is covered by French patents of which the principal one (689, 802, 4, 18, 1955) refers to coatings for metals based on PVC and the methods of manufacture and application. In France, it is exploited by Société Continentale Parker as Parcoplast 300; there are also licencees in Germany, Belgium, England; and arrangements are also being negotiated with the United States. Sweden and Switzerland.

The advantages claimed for Parcoplast 300 are: strong adhesion to metal when a suitable undercoat (also the invention of Plastiques de Saint-Denis) is used; possibility of applying PVC cold, by ordinary paint spray gun in a single layer, to any thickness desired, with no danger of running, shrinkage or swelling. No preheating of the support is required. The coating can be stoved immediately after application; there is no need for preliminary evaporation of solvents. If for practical reasons gelification cannot take place until after a definite time, the treated part may be kept in the open air for 24 hours. Parcoplast 300 can be used in any color including white; unpigmented, it gives a colorless, transparent finish. It has high insulating power — a film 0.1 mm. thick resists a H.F. current of 12,000 volts; high resistance to almost all organic and inorganic acids, all the bases, salts, water (including sea-water); high mechanical resistance. However, contact with solvents must be avoided in use because of the hardening of PVC resulting from plasticizer migration.

In appearance, Parcoplast 300 is a gel having approximately the consistency of mayonaise, and must be diluted with 2 to 4% of a special diluent. Before a metal surface is treated, it must first be degreased and sanded, then the special undercoat is applied by spray gun after it has been brought to the right viscosity; it is always applied at the rate of 150 grams per square meter; then it is dried in air for 10 minutes and stoved at 120-125° C. for 10-15 minutes. After cooling, the Parcoplast 300 is sprayed on to the desired thickness and cured at 160° C. for 30 to 45 minutes. For a surface 0.1 mm. thick, 150-200 grams per square meter are required; for 0.2 mm., 450 grams; for 1 mm., 1.2 to 1.5 kilos.

Parcoplast 300 can be used to solve anti-corrosion problems in the chemical industry and problems of electrical insulation; it is being tested as coating for road and other signs, for accumulators, and to protect metal casks for transporting and storing anchovies, olives, herrings and other food in brine. A French automobile manufacturer is using it for covering steering wheels, and a German firm for camera boxes.

Perkin Centenary Celebration

With the support of leading chemical and dyes societies, preparations are being made for suitable celebration, under the patronage of the Duke of Edinburgh, of the Perkin Centenary. It was in 1856 that William Henry Perkin, then 18 years old, discovered the first synthetic dyestuff that came to be known as "Mauve;" a discovery that led to the development not only of the modern dyestuffs industry, but also of the world's organic chemical industry.

In connection with the centenary celebrations to be held in London early in May, a series of five lectures is being arranged which will deal with the effects of Perkin's discovery on life and industry during the past 100 years. A fund of £100,000 is to be raised which will be used mainly to establish a trust fund to finance Perkin Centenary Scholarships to promote, advance, and encourage technical education relating to all aspects of the fabrication or application of coloring matters.

NAMES in the NEWS

Larry Jacobson

Larry Jacobson has been appointed staff assistant for calcium carbonate sales in the silicate, detergent and calcium division of Diamond Alkali Co., Cleveland, O. **Mr. Jacobson** has had 23 years' diversified experience in the field.

Anthony C. McAuliffe has been named to head the newly-created engineering and construction division of American Cyanamid Co., New York, N. Y. Formerly a general in the United States Army, Mr. McAuliffe will also serve as president of Cyanamid's engineering subsidiary, Chemical Construction Corp.

Theodore P. Malinowski has been appointed development manager, product development department of Atlas Powder Co.'s chemicals division, Wilmington, Del. He previously served with the product development department of Monsanto's plastics division.

Robert U. Haslanger

Robert U. Haslanger has been elected vice president and general manager of Escambia Bay Chemical Corp., Pensacola, Fla. **Mr. Haslanger** was with Monsanto Chemical Co. for a number of years, and more recently with Stauffer Chemical Co. as industrial chemicals sales director and assistant to the president.

Ernie Munkacsy has been appointed sales engineer for Ferro Corp.'s color division, Cleveland, O. In addition to Ohio, **Mr. Munkacsy** will cover Pennsylvania and the western part of New York State. He served as plant manager of Poly-Cyclo Products Co., prior to joining Ferro.

George W. Russell has been appointed general manager, and **Alden R. Loosli** was named assistant general manager of American Cyanamid Co.'s industrial chemicals division, New York, N. Y. **Mr. Russell** formerly served as assistant general manager of the firm's pigments division; **Mr. Loosli,** as assistant general manager of the fine chemicals division.

James H. Flynn has been named service manager of Owens-Illinois Glass Co.'s closure & plastics division, Toledo, O., succeeding the late **Charles C. Neptune. Charles A. Arthur** replaces **Mr. Flynn** as service manager of the plant at St. Charles, Ill.

Lawrence D. Bragg, Jr.

Lawrence D. Bragg, Jr., has been named assistant general manager of General Tire & Rubber Co.'s Respro division, Cranston, R. I. He served with Bolta Products as vice president in charge of production until the firm merged with General Tire in 1954.

Richard S. Cole has been appointed sales manager of Macco Chemical Co.'s oil-base resin adhesives division, Wycliffe, O.

The following appointments have been announced by Carbide & Carbon Chemicals Co., New York, N. Y.: **R. D. Glenn,** as assistant works manager; **F. H. Belden,** as general superintendent of the South Charleston, W. Va., plant; **R. C. Hieronymus,** as a superintendent of the South Charleston plant; and **H. A. Stuewe,** as assistant superintendent of the Texas City, Tex., plant. Both **Mr. Glenn** and **Mr. Belden** have been with the company since 1934, while both **Mr. Hieronymus** and **Mr. Stuewe** joined Carbide in 1936.

Daniel L. Kent has been appointed technical service representative for B. F. Goodrich Chemical Co.'s plastic materials sales department, Cleveland, O. He has been associated with the company for 10 years, serving in the sales service laboratory and in the biochemical development department.

Roland Lehr

Roland Lehr has been appointed president and general manager of Baker Brothers, Inc., Toledo, O., manufacturer of machine tools. Former sales manager of Quincy Compressor Co., Mr. Lehr was also named chairman of the board of Baker.

W. L. Davidson has been appointed assistant director of Food Machinery & Chemical Corp.'s new Central Research Laboratory, Princeton, N. J. **Dr. Davidson** formerly served as research director for the firm's Westvaco Chlor-Alkali division. **Hugo Strange** becomes manager of lab's organic chemistry department, and **S. C. Carniglia** will manage the inorganic and physical chemistry department.

William F. Condon has been appointed sales manager of Cordo Molding Products, Inc., New York, N. Y. A former associate of Owens-Corning Fiberglas Corp. and Virginia Lincoln Corp., **Mr. Condon** will direct sales of Cordopreg preimpregnated reinforced plastic molding products.

J. Philip Smith has been named general manager of Chas. Pfizer & Co.'s chemical sales division, New York, N. Y. He previously served as assistant to the senior vice president.

E. D. Murphy has been named manager of sales control for Carbide & Carbon Chemicals Co., New York, N. Y. **Mr. Murphy** joined the firm in 1925 after being graduated from M.I.T. with a B.S. in Chemical Engineering. Since 1936, he had been manager of the company's Boston sales district.

J. D. Benedito

John D. Benedito has been named general sales manager for Bakelite Co., New York, N. Y. He joined the parent company, Union Carbide & Carbon Corp., in 1935 after graduating from Yale University. He succeeds **H. K. Intemann** who has been named executive vice president of Electro Metallurgical Co., another Carbide division.

Gilbert D'Andrea has been appointed director of design for Bassons Industries Corp., New York, N. Y. An industrial designer with the firm for the past five years, he has developed a number of machine tools and designed many reinforced plastic components.

Paul Bixler has been appointed manager for the international division of F. J. Stokes Machine Co., Philadelphia, Pa. He previously served as Latin-American representative for Armstrong Cork Co., and as manager of Eljer Co.'s export department.

Guy A. Martinelli

Guy A. Martinelli has been appointed sales manager of Sylvan Plastics, Inc., a wholly-owned subsidiary of American Viscose Corp., Philadelphia, Pa. **Robert A. Gift, Jr.,** has been named head of technical service in addition to his sales responsibilities. Both formerly served as sales and technical service representatives for Sylvan in New York. These promotions follow the retirement of **Edwin F. James,** vice president of the firm.

Peter V. Schwab has been appointed Pittsburgh district manager of NRC Equipment Corp., Newton Highlands, Mass. The firm is the sole North American sales representative for the line of high vacuum equipment and components produced by the parent firm, National Research Corp.

Kurt Frisch has been appointed manager of polymer research at Wyandotte Chemicals Corp., Wyandotte, Mich. **Dr. Frisch** will supervise and coordinate development work on synthetic resin intermediates. He previously served with E. F. Houghton & Co., and with General Electric's chemical division.

Nicodemus E. Boyer has joined the research and development department of Hooker Electrochemical Co., Niagara Falls, N. Y. An organic chemist, **Dr. Boyer** has been assigned to the exploratory organic research group.

Harriman H. Dash has been appointed director of research for Foam King, Inc., New York, N. Y. In his new post, he will report directly to the vice president in charge of engineering.

B. R. Sarchet

Trinity Court Studios
John W. Pool, Jr.

Koppers Co., Inc., Pittsburgh, Pa., announced the following four changes in its chemical division: **John W. Pool, Jr.,** as manager of the sales department; **B. R. Sarchet,** as manager of the development department; **H. D. Cooper,** as assistant manager of the sales department; and **R. F. Seubert,** as manager of the eastern district sales office. Both **Mr. Pool** and **Mr. Sarchet** were formerly assistant manager of the sales department. **Mr. Pool** replaces **C. H. Pottenger,** recently appointed vice president and assistant general manager of the division, while **Mr. Sarchet** replaces **F. B. Varga,** recently named vice president of Koppers International, C. A. **Mr. Cooper** previously was manager of the eastern district sales office, while **Mr. Seubert** had been supervisor of the Pittsburgh sales office.

Carbide & Carbon Chemicals Co., New York, N. Y., has announced the appointments of **R. C. Boltz** as eastern division manager; **J. R. Hulten** as central division manager; and **H. P. White** as assistant manager of the Pacific Coast division. The three men formerly were managers of the Newark, Philadelphia, and Chicago districts, respectively.

Robert A. Gift, Jr.

George Baron will be in charge of all plastics' purchases for both Ideal Plastics Corp. and Ideal Toy Corp., both of Hollis, N. Y. **Lawrence Hausberg** has been named director of over-all purchases.

Milton Gallagher has been named director of research and development for the calcium products division of Georgia Marble Co., Tate, Ga. **Dr. Gallagher** has been associated with the Industrial Research Institute of the University of Chattanooga, Owens-Corning Corp., and Tennessee Eastman Corp.

John P. Sheehy has joined the technical service and sales staff of Glyco Products Co., Inc., New York, N. Y. He was formerly with Solvay Process Division, Allied Chemical & Dye Corp., and holds an M.S. in chemistry from Fordham University.

Richard S. Rhodes has been named assistant to the president of Koppers Co., Inc., Pittsburgh, Pa. He has been with the company since 1934, most recently serving as assistant manager of Koppers' production department.

R. L. Duncan, F. J. Rauscher, and **E. R. Young** have been appointed assistant sales managers for Carbide & Carbon Chemicals Co., New York, N. Y. **Mr. Duncan** has been eastern divisional manager since 1954. **Mr. Rauscher** and **Mr. Young** also served as divisional managers of the Southwest and the Central divisions, respectively.

Fabian Bachrach
Fred Nadherny

Fred Nadherny has been named assistant to the vice president and director of sales for Godfrey L. Cabot, Inc., Boston, Mass. Formerly assistant regional sales manager in Akron, O., **Mr. Nadherny** joined the company in 1952 and became a sales representative in 1953. In his new position, he will make his headquarters in Boston.

Erwin W. Brown has been named general manager in charge of plastics for Irvington Varnish & Insulator Division, Minnesota Mining & Mfg. Co., St. Paul, Minn. He joined 3M in 1947 as a member of the central research department; joined the engineering department in 1948; became technical director of the duplicating products division in 1950; was a divisional engineer for magnetic products in 1951; and since 1953 had been a divisional engineer for the company's electrical products group.

Dr. Sydney Steele has been named industrial assistant to **Edward J. Goett,** vice president in charge of the chemicals division of Atlas Powder Co., Wilmington, Del. **Robert J. Reilly** has been named director of the economic evaluations department, chemicals division. This is a new department to which **James Weaver** and **Frank Lyndall, Jr.,** have also been assigned. **L. Hastings Lyon** has been transferred to the newly created marketing research section of the production development department.

New Materials

Write item numbers on Readers' Service card to obtain more information.

Polysulfide Potting Compound

A two-part, flexible sealant, which cures at room temperature, has been introduced by Coast Pro-Seal & Mfg. Co. Designated Pro-Seal #727 potting compound, the material should not be thinned. Directions call for mixing 100 parts by weight with 12 parts of Pro-Seal #727-A curing agent, and blending for at least three minutes. It can then be applied by pressure gun, flow gun, or spatula.

The compound has a solids content of approximately 97%, yet is pourable. A viscosity of 600-800 poises is reported, and the weight per gallon is 15 pounds. Off-white in color, Pro-Seal cures to a light brown material of relatively high tensile strength and high elongation. It is exceptionally resistant to water and weathering, and has excellent natural aging features.

The cured material is flexible below —60° F., and resists gasolines, oils, and pressure lubricants. Electrical properties meet or excel all minimum values set forth in MIL-S-8516A for electrical connector potting compounds.

Readers' Service Item M-1

Non-Bleeding Azo Pigment

A non-resinated, non-bleeding azo pigment, based on beta-oxy naphthoic acid, has been introduced by the pigment, color, and chemical division of Sherwin-Williams Co. Known as Brilliant Toning Red CP 1269, the pigment is expected to have numerous applications in the plastics industry due to its excellent heat resistance, brilliant shades, and non-bleeding characteristics.

Reported to be 15% stronger and brighter than competitive pigments, CP 1269 is of the general type known as Permanent Red 2B. It is easily dispersed, and is said to be unaffected by plasticizers, water, or solvents. Property data are reported as follows:

Specific gravity	1.68
Weight, lbs./gal.	13.99
Bulking value, gal./lb.	0.07148
Oil absorption	44
Light resistance, full shade	Very good
Tints	Good
Ease of grinding	Good

Readers' Service Item M-2

Aqueous Mold Release Agent

An aqueous suspension of a high melting, non-toxic synthetic wax, called Dispersion 33, has been introduced by Baker Castor Oil Co. Highly compatible with resins, waxes, and miscellaneous materials, the material offers excellent lubricity, plus anti-blocking and solvent-resistant properties.

When used as a mold release agent, a thin film of Dispersion 33 is brushed onto the mold. Heat vaporizes the water and fuses the wax particles into a continuous, adherent film. In many cases, it is said to have proven superior to silicone sprays both in release properties and in permitting a greater number of runs before re-lubrication. An example is the molding of melamine-impregnated paper plates, where the wax's high-temperature stability prevents discoloration.

Dispersion 33 can be incorporated in synthetic resin emulsions, rubber and vinyl latices, and other water-based systems to give anti-blocking, anti-tack, oil resistance, and other properties. When subjected to temperatures above 185° F., the wax particles fuse to become part of the vehicle. If the temperatures remain below that point, the wax component remains as micron-sized particles and functions as an inert filter.

Alone or modified, the dispersion can be used to impregnate paper, cotton, and other porous materials. On subjection to heat, the materials fuse to form a continuous film. Dispersion 33 is shipped in five- and 55-gallon, open-head drums, and should be stored at room temperature.

Readers' Service Item M-3

Reinforced Plastic Laminates

	EGP	EHG	EEG	ESA	ESB	ETS	EGC	EAL
Tensile strength, psi.	12,000	18,000	9,100	11,500	10,800	6,600	43,100	8,500
Compressive strength, edgewise, psi.	—	28,500	28,500	27,500	25,000	20,000	31,500	12,300
Flatwise, psi.	44,000	50,000	44,000	50,000	45,000	33,000	66,000	28,500
Flexural strength, psi.	25,000	32,000	23,000	25,000	25,000	16,000	43,800	—
Modulus of elasticity, psi. x 10^6	2	1.7	1.4	1.8	1.7	1.0	2.3	—
Hardness, Rockwell M	110	110	105	105	107	90	108	95
Impact strength, Izod, ft.lbs./in.	15	16	8.3	11.4	11.8	7.6	20	—
Bonding strength, psi.	1,000	1,250	660	930	740	1,000	1,250	—
Water absorption, % in 24 hrs.	0.5	0.42	0.41	0.34	0.1	0.15	0.9	0.77
Coefficient of thermal expansion	2.0	1.5	2.4	3.0	2.4	3.0	1.4	—
Heat distortion point, °C.	300	300	300	280	300	300	300	300
Maximum operating temperature, °C.	150	160	105	155	150	150	160	155
Arc resistance, seconds	135	125	97	140	125	135	130	60
Dielectric constant at 60 cycles	4.34	4.24	4.49	4.5	4.4	4.66	4.66	4.83
At 1,000,000 cycles	4.1	4.03	4.29	4.11	3.99	4.4	4.42	—
Power factor at 60 cycles	0.0115	0.0106	0.0188	0.018	0.017	0.04	0.024	0.04
At 1,000,000 cycles	0.0139	0.0077	0.0076	0.009	0.012	0.01	0.0087	—

A series of eight fibrous glass-reinforced polyester laminates, which satisfy the requirements of NEMA grade classification GPO-1 for class B insulating materials, has been introduced by Hays Mfg. Co. Designated Haysite, the laminates feature ease of fabrication; they can be sawed, sheared, drilled, turned, cold-punched, and nailed without cracking. Resistance to arc tracking is reportedly excellent.

Grade EGP is a general-purpose laminate with good over-all properties. Properties for Grade EHG are slightly better, especially with reference to punching and machining. Grade EEG has a lower specific gravity, and consequently lower weight and cost. Grades ESA and ESB are self-extinguishing laminates, the latter possessing somewhat superior machining properties. Grade ETS is of low cost, and is intended primarily for use as spacer sticks in dry-type transformers. Grade EGC is the premium laminate, and has the highest mechanical properties of the series. Grade EAL is a glass mat asbestos paper-reinforced laminate, which is both tough and flexible.

Physical and electrical properties are quoted as above.

Readers' Service Item M-4

Semi-Rigid Epoxy Resin

A modified epoxy resin has been developed by Furane Plastics, Inc., for electronic insulation applications requiring a semi-rigid, low-modulus material which still offers high electrical resistance in a temperature range of —65 to +300° F. Designated Epocast 15, the material is said to have excellent adhesion to metals, ceramics, and glass.

Epocast 15 is offered as a two-component clear impregnant, and as a two-component filled potting and encapsulating medium. A pot life of 3-4 days at 80° F. is claimed, and recommended curing schedules call for six hours at 200° F. or three hours at 250° F. Other properties are reported as follows:

Dielectric constant	3.4
Loss factor, 110 kc.	0.017
At 1.0 mc.	0.027
At 11.0 mc.	0.038
Volume resistivity at 300° F., ohms/cm.	1.1×10^{10}
Tensile elongation, %	135

Readers' Service Item M-5

VANSTAY

Vanderbilt Materials for Vinyls

VANSTAY C Provides efficient heat stabilization at low cost in tile formulations.

VANSTAY L Recommended for maximum light stability and improved natural ageing in all vinyl resin compositions.

VANSTAY HT–VANSTAY S

This combination provides excellent heat protection for vinyl compositions during processing and in service.

VANSTAY N Recommended for use with Vanstay S in non-plating heat stabilizer systems.

VANCIDE 89 Non-metallic fungicide and bactericide effective in vegetable plasticized vinyls.

Our Technical Service Representatives will gladly demonstrate the merits of our materials in your plant and assist in solving production problems.

R. T. Vanderbilt Co., INC. 230 Park Ave. • New York 17, N. Y.

Phenolic Molding Compound

Commercial availability of G-E 12906, an impact phenolic molding compound, has been announced by the chemical materials department of General Electric Co. Black in color, the material is reportedly suitable for automatic molding processes due to its excellent granulation and fast-curing properties. Other advantages claimed for the material include uniform pill weight and excellent preformability in tableting machines.

Filled with wood-flour and cotton-flock, G-E 12906 is said to produce molded parts having a finish superior to those obtained from conventional impact materials. Molded parts should not be subjected to temperatures in excess of 300° F. Property data are reported as follows:

Density, gms./100 cc.	50
Bulk factor	2.7
Powder pourability, sec./100 cc.	28
Screen mesh	14
Flow range	100-140
Impact strength, Izod.	0.42
Flexural strength, psi.	10,000
Tensile strength, psi.	6,000
Compressive strength, psi.	25,000
Specific gravity	1.36
Water absorption, 48 hrs, %	0.8
Shrinkage, mils/in.	6.5
Hardness, Rockwell M.	96
Heat distortion, °F	300
Dielectric strength, 60 cycles @ 25°C., v./min.	325
Power factor, 60 cycles, dry	0.25
Dielectric constant, 60 cycles, dry	10
Volume resistivity, ohm cm. units	2×10^{1}
Insulation resistance, megohms	7×10^{4}

Readers' Service Item M-6

Micro-Fiber Glass Papers

A new engineering material called Tissuglas, consisting essentially of microglass fibers to which a binder and/or impregnations have been added, has been placed on the market by American Machine & Foundry Co. The ultra-soft, tissue-like films are available in thicknesses of 0.5-13 mils and widths to 40 inches.

Plain Tissuglas can be as much as 95% air by volume, thereby providing a carrier sheet composed of up to 95% resin, the balance being inert carrier. Wet strength is approximately 70% of dry tensile strength, which ranges from 95-880 psi. Breaking strength is reported at 200-1,350 grams per inch of width. Chemical and thermal properties are largely determined by the glass and impregnant contents.

Tissuglas can be furnished with a binder which is insoluble in aqueous and most organic solvents. Successful impregnations to date include melamine, epoxy, silicone, PVC, polytetrafluoroethylene, and polyester resins. In the case of resin impregnations, the materials are known as Fiberfilm. Amfoil is Tissuglas coated with aluminum and polytetrafluoroethylene on both sides. Decorative printing, insulation, printed circuitry, packaging, release agents, etc., are some of the potential applications for the material.

Readers' Service Item M-7

New Equipment

Write item numbers on Readers' Service card to obtain more information.

Grieve-Hendry portable electric oven

Portable Electric Oven

A low-cost, portable industrial electric oven is available from Grieve-Hendry Co., Inc., for use in all types of industrial applications and laboratory work. The oven features uniform temperature throughout; fresh air is drawn in and stale air driven out through specially located vents by means of a fan driven by a motor mounted outside the unit. An adjustable damper gives a wide range of constant temperatures, and the design is said to eliminate any possibility of stratification.

The oven, designated Model CR-1, is so constructed that it will nest atop a similar unit, permitting operation of the ovens either individually or in groups. In such group operation, selected ovens can be cut-out or heated at different temperatures, making the units ideal for production-line use. Of heavy-gage steel construction, the oven has asbestos air-cell insulation, a removable shelf and drip pan, and is furnished ready for operation. The unit is capable of heating to 225° in 15 minutes, and has the following inside dimensions: width, 28½ inches; depth, 24 inches; and height, 20½ inches. Other models for operation at higher temperatures can be furnished.

Readers' Service Item E-1

High-Heat Pressure Gauge

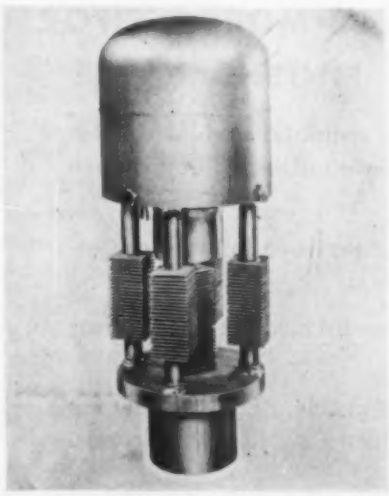
A compact precision gauge designed to give continuous, accurate readings of pressure under prolonged exposure to temperatures of 1,000° F. and a radiation flux of 10^8 Roentgens per hour has been introduced by Callery Chemical Co. Designated the Callery High Temperature Pressure Gauge, Model C, the instrument operates on single-phase alternating current from 60-400 cycles per hour.

The transmitter can be mounted in any position on piping or a vessel by a simple welded joint. No air supply is needed for balancing, and only a four-wire, 16-BWG shielded cable is needed to connect the transmitter to the indicating or recording instruments. When used in regions of high radiation flux, a mineral-insulated cable must be employed.

The instrument consists essentially of a pressure-sensing bellows and a differential transformer, which together make up a single transmitter unit. Application is not limited to any specific liquid or gas, since the bellows can be manufactured from a variety of resistant materials.

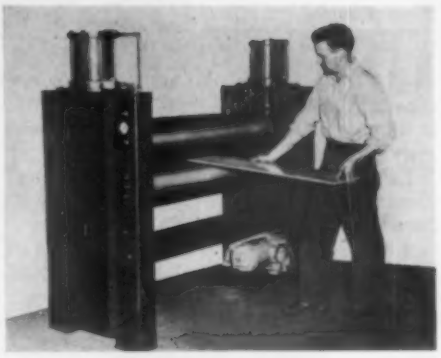
Changes in electrical output are measured in the secondary of the differential transformer through movement of the core. Since the core is directly connected with the bellows, any change in pressure on the latter causes a directly proportional movement of the core. The bellows also serves as a secondary seal.

Pressure range is determined by a balancing spring located in the linkage between core and bellows. Maximum movement is 0.05-inch for full-scale displacement. The Model C Gauge has passed U. S. Navy vibration and shock tests, and is unaffected by temperature fluctuations. Dimensions of the transmitter include a height of 14 inches, and a 4-6 inch diameter. The unit weighs 20 pounds.



Callery Model C High Temperature Pressure Gauge.

Readers' Service Item E-2



Rodney Hunt Wring-Master Rotary Press.

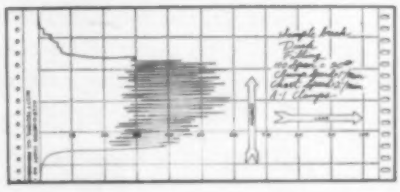
Rotary Laminating Press

The Wring-Master Rotary Press, a recent introduction by Rodney Hunt Machine Co., is said to be particularly suited for contact-bond adhesives and the assembly-line production of laminated panels. Based on the Wring-Master line of pneumatic squeezers for the textile industry, the new model has heavy steel-plate side frames for floor mounting, and direct-acting cylinders for applying pressure to the top roll. This direct-pressure principle assures vertical alignment of the rolls regardless of panel thickness.

The press is equipped with a positive nip adjustment for precise setting of the pressure roll gap to accommodate panels up to five inches thick. The panels are pulled through the press automatically at speeds

TESTED IS TRUSTED

TRUE tear test by Scott "Accr-O-Meter"



This is a true tear evaluation representing a tear test on textile fabric but indicative of the precise detail that can be obtained in tear test on plastic films. Scott "Accr-O-Meter" Constant-Rate-of-Extension equipment makes possible this improved result from A.S.T.M. procedures.

REQUEST LITERATURE

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SCOTT TESTERS, INC.

149 Blackstone St., Providence, R. I.

of 15-30 feet per minute. A 2½-inch diameter neoprene-covered stabilizing roll is mounted directly behind the nip to prevent fluttering of the rigid panels.

Laboratory tests indicate that 150-200 pounds of pressure were required to produce satisfactory bonds with the newer contact adhesives. The Wring-Master unit can be loaded up to 8,000 pounds, which would result in a linear load of 175 pounds per inch on a 48-inch wide panel. In laminating lighter materials, pressures as low as 15-25 pounds should be used to avoid crushing the core.

Specifications for the press are listed as follows:

Lower roll height, in.	36
Roll diameter, in.	10
Pneumatic cylinder diameter, in.	8
Roll face, in.	54
Cylinder stroke, in.	6

Air controls include an operating valve, air pressure regulator, lubricator and gage, automatic air filter, and safety valve. Controls are flush-mounted in the end-frame. A one-hp. variable-speed drive unit operates the rolls.

Readers' Service Item E-3

Semi-Automatic Markers

A new machine for imprinting size, color, and trademark designs on flat parts at production rates has been placed on the market by Markem Machine Co. Designated Model 25AF, the machine has an imprint area ranging from 2¾ by 9 inches to 5 by 11 inches, depending on whether masterplates, typebars, or rubber plates are used.

Up to 75 imprints per minute can be made with the machine. Semi-automatic operation is provided by use of a special work fixture which has drop-gage pins for holding the piece during marking. These pins automatically retract to release the piece which is fed onto a short take-away conveyor. Change in imprint is easily and quickly accomplished, thereby eliminating the need for maintaining large inventories with preprinted legends.

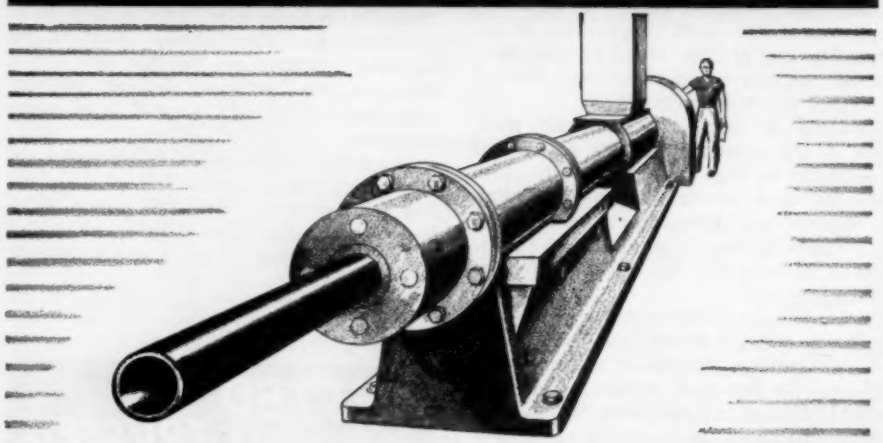
Specifications are reported as follows:

Maximum imprint area:	
Masterplate, hinged chase, in	2¾ x 9
Masterplate chase, in	4¾ x 9
Typebars, in	4¾ x 9
Rubber plates, in	5 x 11
Drive, hp	⅓
Floor space required, in	31 x 36
Height, in	65
Weight, lbs	800

Markem Model 25AF marking machine.

Readers' Service Item E-4

"Colloid Corner" by COLUMBIAN



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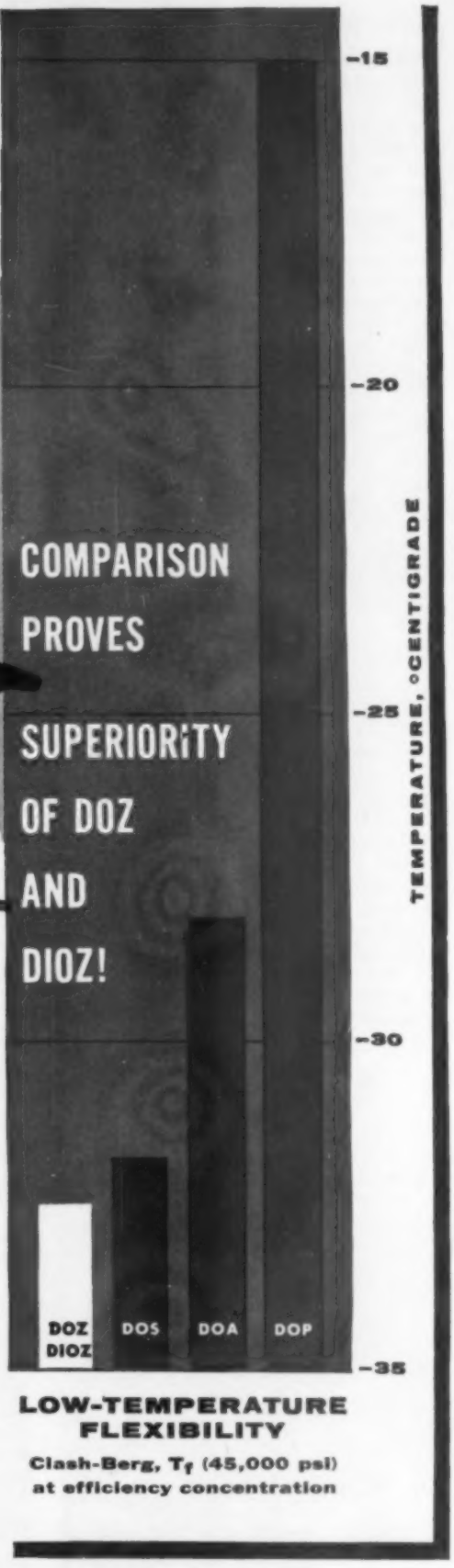

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Eskimos and their low-temperature problems aside—what about yours! Fabricators of plastic items will be more receptive to your vinyl products if you can offer them superior low-temperature flexibility . . . like that provided by Plastoleins DOZ and DIOZ.

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New Products

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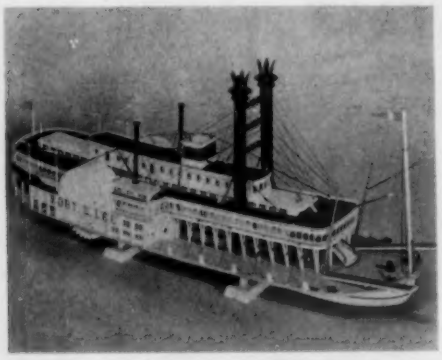


Pyro Plastics' scale-model river boat.

Styrene Model River Boat

A scale model of the famous Mississippi river boat, the "Rob't E. Lee," is presently available in a do-it-yourself kit of 360 Lustrex styrene parts from Pyro Plastics Co. Designed to scale, the 22-inch model required two years of effort in assembling data, and $65,000 before the kit could be produced.

Included in the kit is a complete history of the boat, highlighted by the famous 1870 race with the Natchez. The material used in the components, Lustrex, is a product of Monsanto Chemical Co.

Readers' Service Item P-1

Geon vinyl cover for outdoor terminal connections. Inset shows comparative size.

Vinyl Pothead Cover

A vinyl plastic cover for lead-in wire terminal connections on outdoor potheads has been developed by Steere Enterprises, Inc., in cooperation with Cleveland Electric Illuminating Co. Made from a plastisol based on B. F. Goodrich's Geon vinyl resin, the device is said to eliminate the need for extensive electrical taping and prevent flash-overs.

The plastic cover has excellent dielectric strength, and indefinitely resists the effects of sun, rain, and cold. Installation is easily accomplished by slipping terminal leads through two openings in the bottom of the trouser-shaped plastic cover (see inset in photo), and attaching them to the electrical posts in the pothead. The vinyl cover is secured in place by wrapping electrical tape around the ends.

Readers' Service Item P-2

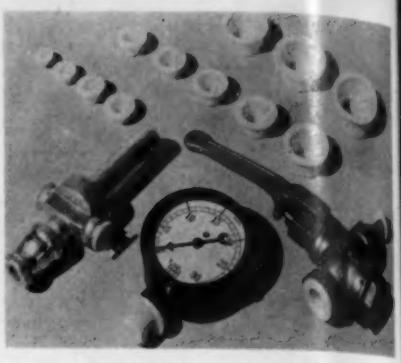
National Kitchen cabinets with reinforced plastic panels.

Plastic Kitchen Cabinet

A new line of wood kitchen cabinets, featuring Lusterite (fibrous glass-reinforced polyester) sliding doors and Formica counter work surfaces, has been introduced by National Kitchens. Featuring a textured, crinkle finish, the corrugated panels provide non-warping sliding doors in six decorator colors.

The panels eliminate the necessity of hardware, and offer ease of cleaning. Among the pieces offered are short wall cabinets, standard wall cabinets, base cabinets, one-piece combination sink bases, range bases, and oven cabinets for built-in units.

Readers' Service Item P-3



Clover polyethylene plugs and caps.

Polyethylene Thread Protectors

Caps and plugs for both externally- and internally-threaded machine parts have been introduced by Clover Industries, Inc. Molded from Eastman Chemical's Tenite polyethylene, they come in lustrous green and yellow colors. Besides being resilient, the caps and plugs are available in a number of sizes and shapes to fit all types of threads and openings.

Readers' Service Item P-4

Metallized Nylon Hardware

Kitchen cabinet and bathroom fixtures of vacuum metallized nylon have been placed on the market by Mirra-Cote, Inc. Light in weight, nylon is said to provide life-time strength plus dimensional stability. The mounting screw cuts its own threads in the material, thus achieving a perfect fit.

Knobs, door handles, towel bars, soap dishes, tumbler holders, and toilet tissue holders are covered with a thin film of tarnish-proof chrome, brass, or copper under high vacuum. This process eliminates such expensive steps as polishing, tumbling, and buffing, and lowers the end-price considerably in spite of nylon's relatively high cost.

Mounting posts for the bathroom fixtures are die-cast zinc, and are vacuum metallized. Both soap dish and tumbler holder have removable styrene trays. The bath items are packaged in a plastic bubble for sales appeal and protection.

Mirra-Cote cabinet hardware.

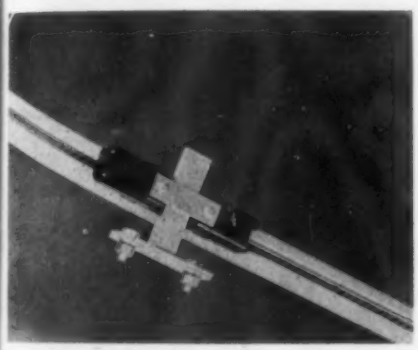
Readers' Service Item P-5

Rigid Vinyl Conductor System

An enclosed conductor system for flexible cranes and monorails, which is said to meet all the requirements of safety electrification, is now available through the Insul-8 Corp. A rigid vinyl extrusion for the metal contact conductor "Insul-8 Bar" was fabricated by Kerr Industries, using a special combination of Goodrich Geon vinyls which were compounded by Maclin Co.

The extruded piece is U-shaped for snug fit around the conductor, which can enclose from 3-12 power lines. The contact slot can be on the bottom or along the side, depending on structural requirements. High dielectric strength and low power loss are features of the material itself. Though the average speed of an overhead crane rarely exceeds 450 feet per minute, the system can accommodate speeds of 900-1,500 feet per minute.

The insulator is colored to comply with code requirements, and will not warp. It also has high chemical and abrasion resistance. Principal selling point is the elimination of physical contact with uninsulated wires, a common fault with overhead power lifts.



Insul-8 Bar with side contact slot.

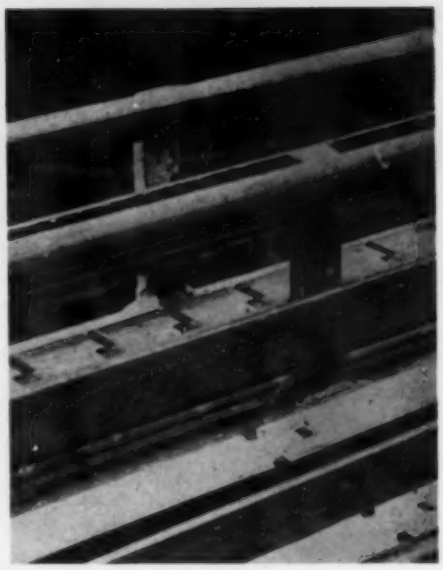
Readers' Service Item P-6

Nylon Conveyor Wear Strips

Conveyor line wear strips are being molded of Du Pont's Zytel nylon resin by Fenco, Inc., for use in food processing plants. Called Nylite, the wear strips were designed for use with nylon conveyor links, but have proven equally effective with conventional metal chains.

Due to nylon's low coefficient of friction, no lubricants are required. This is particularly important in food processing, where the danger of food contamination must be kept to a minimum. The strips are installed over existing conveyor ways. A single molded prong on each strip is pressed through a hole drilled in the "way" and secured with a stainless steel fastener.

Test installations indicate the strips will outwear metal strips of comparable dimensions. Additional features include reduced power requirements, smoother start-up, quieter operation, and ability to withstand steam sterilization.



Nylite wear strips provide a continuous nylon surface for the chain.

Readers' Service Item P-7

Fire-Resistant Lighting Panels

A complete line of fire-retardant lighting panels, both flat and corrugated, has been placed on the market by Filon Plastics Corp. The brightly-colored, translucent sheets are made of Hooker Electrochemical's Hetron polyester resin reinforced with glass fibers.

UL-listed and labeled panels can be obtained with flame-spread values of 40-75 by the Tunnel test specified by ASTM. This compares with ratings of 0 for asbestos, 100 for red oak, and more than 400 for ordinary polyester panels. The Filon line includes panels for roofing, sky-lighting, and side-lighting.

Filon's fire-retardant lighting panels.

Readers' Service Item P-8

Woodgrain Thermoplastic Sheet

A realistic woodgrain finish is available in the rubber-modified styrene sheets produced by Campco division, Chicago Molded Products Corp. A permanent and integral part of the sheet, the three finishes (blond mahogany, dark mahogany, and driftwood) require no protective coatings.

Applications for the sheet should be numerous, especially in the display filed. Vacuum formed, three-dimensional parts can be produced at a fraction of the time and cost required for natural wood. The result is a stronger and lighter display.

As shown in the accompanying photograph of a Kirby-Cogeshall-Steinau plaque, the subject appears in bas-relief although formed from a single sheet. The effect of an inlaid background and mahogany frame is also achieved, and the dog is printed separately in an opaque color.

Simulated framed painting is vacuum formed from single Campco sheet.

Readers' Service Item P-9

Spray Coat for Phenolics

A new enamel which is said to provide a hard, chip-resistant finish for molded phenolic parts has been developed by Rexton Finishes, Inc. Called Rexclad, the enamel demonstrated excellent adhesion to the glossiest of surfaces, and requires but one spray-coat application.

A range of finishes are available, and an almost unlimited choice of color. Rexclad can be air-dried, force-dried, or baked, and is highly resistant to heat, oils, and most common chemicals. The air-dried pieces can be handled in two hours and packed in 24. Force-drying at 140° F. for 10 minutes permits immediate handling and 30-minute packing. Baking at 250° F. for an hour allows immediate handling and packing.

Spray formulation calls for one part Rexclad, ½ part Rexalator 85-C-950, and ½ part Rexclad reducer. Pot life of the mixture is approximately 36 hours.

Readers' Service Item P-10

New Literature

Write item numbers on Readers' Service card to obtain copies of literature.

Publications of Marblette Corp.:
"Metal Forming Bulletins." 6 pages. Suggested formulations and methods of making stretch press dies, draw dies, and hydroform dies are given in this series of bulletins

Readers' Service Item L-1

"Epoxy Laminating Resins." 1 page. The firm's die surface laminating resin #602 is described, along with directions for mixing.

Readers' Service Item L-2

"Epoxy Die Surface Casting Resin." 2 pages. Physical properties, formulations, and properties of castings made from the company's #612 B resin are given in this bulletin.

Readers' Service Item L-3

"Epoxy Die Surface Coat Resin #613." 2 pages. Physical properties of the resin and the finished casting are listed along with procedures for mixing.

Readers' Service Item L-4

"Plastics in the Foundry Industry." 6 pages. Loose patterns, match plates, core prints, blown core boxes, core driers, and methods of preparing molds for castings are described. Schematic drawings are included.

Readers' Service Item L-5

"Epocast Physical Property Chart — Typical Values." Bulletin EP-56-98. Furane Plastics, Inc. Tabular data are provided on the physical properties, compositions, and functions of the company's epoxy resins for tooling, casting, laminating, and gel coating applications.

Readers' Service Item L-6

"Pliovic DB80V and DB90V Dry Blending Vinyl Resins." 53-360. Chemical division, Goodyear Tire & Rubber Co., Inc. 2 pages. Typical properties and their analyses are covered in this bulletin.

Readers' Service Item L-7

"Process Plants by Blaw-Knox." Bulletin No. 2514. Blaw-Knox Co. 20 pages. This illustrated catalog outlines design, engineering, construction, and initial operation of process industries plants by the firm's chemical plants division. Subject matter is classified by project.

Readers' Service Item L-8

"Speedylectric Packaged Steam Generators." Bulletin SG-100. Pantex Mfg. Corp. 6 pages. Specifications, dimensional data, and an outline of the basic principle of Speedylectric electrode steam generators are included in this illustrated bulletin. Also covered are the firm's steam-jet cleaners, process heaters, and steam spray-painting units.

Readers' Service Item L-9

"Plastics Catalog and Price List." Cadillac Plastic & Chemical Co. 58 pages. This catalog covers the thermoplastic and phenolic sheets, rods, tubes, and films; miscellaneous resins; cements; and supplies stocked by the company. Information given includes available sizes, weights, color ranges, purchasing specifications, and prices. A table of comparative chemical, electrical, and mechanical properties is included.

Readers' Service Item L-10

"Sequestrene Bibliography (1953-1954)." Geigy Industrial Chemicals. 20 pages. This bibliography consists of an alphabetical listing, by author, of all the articles published on ethylenediamine tetraacetic acid during the above-mentioned period; Sequestrene being Geigy's proprietary name for the material.

Readers' Service Item L-11

"Hydraulic Presses for Plastic Molding." R. D. Wood Co. 4 pages. Specifications, dimensions, and photographs of the firm's molding, laminating, curing, embossing, and combination presses are included in this bulletin.

Readers' Service Item L-12

"PMDA in Epoxy Resins." Explosives department, E. I. du Pont de Nemours & Co., Inc. 16 pages. The use of pyromellitic dianhydride as a curing agent in epoxy resins is described in the light of its physical, electrical, and chemical properties. A description of its uses in epoxy castings, epoxy-glass laminates, and in epoxy coatings is included.

Readers' Service Item L-13

"High Voltage Electron-Beam Processing." Bulletin E. High Voltage Engineering Corp. 34 pages. Types of radiation and their sources, electron beams applied to processing, dosage, penetration, efficiency, absorption, output, and production capacity are covered in this booklet. Electron accelerators manufactured by the firm are described in detail; including photographs, schematic drawings, and specifications.

Readers' Service Item L-14

"Esters by Glyco." Glyco Products Co., Inc. 24 pages. This 1956 edition of the firm's ester catalog gives descriptions, specifications, and uses for fatty acid esters of glycerol, glycols, and polyethylene glycols. These non-ionic surfactants are used as emulsifying agents, stabilizers, penetrants, defoamers, and plasticizers.

Readers' Service Item L-15

"Custom Molding of All Thermosetting Plastics." Specialty Insulation Mfg. Co. 4 pages. This illustrated booklet describes the firm's facilities for compression molding, inspection, and finishing of electrical, electronic, mechanical, aircraft, automotive, and business machine components.

Readers' Service Item L-16

"Ethanolamines." Nitrogen division, Allied Chemical & Dye Corp. 54 pages. Monoethanolamine, diethanolamine, and triethanolamine are described, along with a listing of their applications, chemical and physical properties, physiological properties, shipping specifications, handling and storage features, and a bibliography. Analytical procedures and graphical illustrations are included.

Readers' Service Item L-17

"Epibond Adhesives." Furane Plastics. 6 pages. This folder is essentially a chart listing properties, pot life, formulations, cure conditions, and tensile lap shear strength for eight of the company's epoxy adhesives.

Readers' Service Item L-18

Book Reviews

"Plastics Progress—1955." Edited by Phillip Morgan. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. Cloth, 6 by 9½ inches, 440 pages. Price, $17.50.

This volume, the third to appear under the title of "Plastics Progress," contains the full report of the third British Plastics Convention. The 20 papers presented at the Convention are given in final form, with the printed text often being substantially longer than the paper delivered at the meeting. This expansion is particularly rewarding since many of the contributed papers were based on original work, and are now being published for the first time.

In organization, the volume follows the Convention program in that the papers are grouped into chapters under the general headings of polymer structure and properties; expanded plastics; thermoplastics; extrusion; work study and productivity; injection molding patents foundry resins; and glass-reinforced plastics. Complete transcripts of the discussion which followed each of these subjects are included in the book, and follow the informal style in which they were presented and recorded.

The papers and their authors are as follows: "The Snythesis of New Types of Addition Polymers," H. W. Melville; "Recent Advances in the Radiation Treatment of Polymers," A. Charlesby; "The Molecular Weight of Polythene—Its Measurement and Significance," S. W. Hawkins; "The Chemistry of Modern Blowing Agents," R. A. Reed; "The Technology and Uses of Polyurethane Foams," L. N. Phillips; "Dispersions of Polytetrafluoroethylene," H. M. Whitcut; "New Nylon Polymers and Compositions," R. H. Birtles; "Fundamental Problems of Single-Screw Thermoplastic Extruders," E. Gaspar; "Work Study and the Plastics Industry," J. G. Moore; "Productivity and Methods in Molding," A. L. Sparshott; "The Effect of Injection Molding Variables on the Quality of Moldings," K. C. Bryant and G. Hulse; "Recent Advances in Injection Molding Techniques and in the Evaluation of Molding Materials," G. Campbell, "Runners, Gages, and Vents for Thermoplastic Molds," A. G. Elwell; "British and International Patent Practice as It Relates to the Plastics Industry," by a chartered patent agent; "Recent Developments in the Use of Plastics in the Foundry," P. G. Pentz; "Consistency in Glass-Reinforced Moldings," J. Rees; "Glass-Reinforced Plastics in Automobile Construction Their Advantages and Limitations," H. Silman; "Chemical Engineering Possibilities of Glass-Reinforced Plastics, with Special Reference to Polyester Resins," V. Evans and J. R. Stevenson; "The Testing and Development of High-Quality Glass Fiber Polyester Laminates," P. H. H. Bishop and E. Haythornthwaite; and "Epoxide Resin-Glass Laminates," W. J. Marmion. A subject index concludes the book.

"Dielectric Dispersion Behavior of Selected Natural Polymers." Fordham University for Wright Air Development Center. Order PB 111857 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 88 pages. Price, $2.25.

Electrical measurements were made from 10^2-10^7 cycles at 25-150° C., using bridge methods. Polymer solutions in dioxane and solid polymer discs, both containing varying amounts of plasticizers, were studied. The dielectric behavior of most amylopectin acetate-plasticizer systems showed considerable differences, and the dielectric constants were observed to decrease in value as the frequency of the applied field was increased.

"Methods of Measuring the Birefringence of Aircraft Glazing Materials." Naval Research Laboratory. Order PB 111825 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 28 pages. Price 75¢.

Three methods of measuring the birefringence (double refraction) of hot-worked acrylics are described in this report. Two methods avoid the necessity of cutting a test specimen by using oblique incidence of light upon the sample. The other method, which requires partial destruction of the sheet, is suitable for special cases only.

Equipment and procedures are described in detail. Analysis of the precision of nondestructive tests shows that one of them will yield an accuracy of 5% or better. Results of all three types were found to be related. An interim report, it demonstrates the use of graphs for shortening the computation of birefringence. This technique is commonly used by crystallographers.

"Alkyd Resins for Vinyl Finishes, Part II—Atmospheric Resistance." S. B. Cecilius, Naval Research Laboratory. Order PB 111824 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 17 pages. Price, 50¢.

A report of results obtained in a study undertaken to establish the type of alkyd resin which would give the best performance when used in combination with vinyl resin as topside coatings for navy ships. Test panels were prepared, using several series of alkyd resins, and exposed to different weathering, including salt spray. The long-term outdoor weathering test indicated that the maximum corrosion resistance for the glycerol products is 28-30% of the phthalic anhydride level, with little differences noted between the various fatty acids used. This test also showed that pentaerythritol products gave the best performance at the 24% phthalic anhydride level. The glycerol-sorbitol mixtures performed about the same as the straight glycerol products at 26% phthalic anhydride content.

"Polymer Processes." Edited by Calvin E. Schildknecht. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6 by 9 inches, 931 pages. Price, $19.50.

This volume is the tenth in the publisher's series of monographs on high polymers, and deals with the chemical technology of plastics, resins, rubbers, adhesives, and fibers. Throughout the text, polymer processes and reactions are related to basic concepts of organic and physical chemistry wherever possible, although art and production have advanced beyond theory in some fields. References to the literature and patents, as well as the experience of the contributing authors, are used to present a clear picture of the current status of art, techniques, and knowledge in the field.

The book consists of 18 chapters written by industrial authorities. The chapters and their authors are as follows: "Introduction to Free Radical Polymerization," J. H. Baxendale; "Polymerizations in Bulk," Mr. Schildknecht; "Polymerizations in Suspension," Ernst Trommsdorff and Mr. Schildknecht; "Polymerizations in Emulsion," H. L. Williams; "Polymerizations in Solution," Mr. Schildknecht; "Ionic Polymerizations," Mr. Schildknecht; "Polyamides and Polyesters," D. G. Bannerman and E. E. Magat; "Condensations with Formaldehyde," T. J. Suen; "Cellulose and Cellulose Derivatives," B. G. Ranby and S. A. Rydholm; "Epoxy Resins," S. S. Stivala; "Polysulfide Polymers," E. M. Fettes and J. S. Jorczak; "New Adhesives," W. J. Powers; "Stabilization of Polymers," Mr. Schildknecht; "Paste Techniques," W. D. Todd; "Latex Techniques," G. J. Antfinger and N. H. Sherwood; "Compounding and Processing Rubbers and Resins," G. S. Garvin; "Polymer Reinforcement (Polyester, Epoxy, Silicone, and Phenolic Resins)," H. L. Gerhart and E. W. Moffett; and "Spinning and Drawing Fibers," J. L. Riley.

The book concludes with an appendix of abbreviations and a temperature conversion table, and a comprehensive subject index.

Abstracts of Important Articles

Materials

"Long-Chain Vinyl Esters and Ethers—Preparation from Commercial Raw Materials," L. E. Craig, R. F. Kleinschmidt, E. S. Miller, J. M. Wilkinson, Jr., R. W. Davis, C. F. Montross, and William S. Port, *Ind. Eng. Chem.*, 47, 9, Part I, 1702 (Sept. 1955).

The polymerizations of high-molecular weight monomers derived from long-chain fatty acids and alcohols are discussed; particularly vinyl esters and ethers. Equipment, procedures, isolation, purification, specification, and polymerizability are covered for vinyl stearate, vinyl oleate, octadecyl vinyl ether, and oleyl vinyl ether.

"Cost Estimate on Technical Grade Vinyl Stearate," Clifford S. Redfield, William S. Port, and Daniel Swern, *Ind. Eng. Chem.*, 47, 9, Part I, 1707 (Sept. 1955).

The process of preparing vinyl stearate from stearic acid is described, and estimates are based on a net return of 12%. Tables are included giving equipment cost, capital expenditures, cost sheet, operational analysis, and a summary.

"New Epoxide Resins by Reaction of Epichlorohydrin with Sulfonamides," Merrill Cohen, *Ind. Eng. Chem.*, 47, 10, 2095 (Oct. 1955).

The common, commercial method for preparing epoxides involves the reaction of bisphenol with epichlorohydrin. Since monofunctional, secondary sulfonamides and primary sulfonamides also contain acidic hydrogen atoms, they can be substituted for bisphenol in the reaction. Procedures and reactions are described, along with a discussion of the properties of epoxides formed in this manner.

"Aromatics in Fibers and Films," G. P. Hoff and J. L. Martin, *Ind. Eng. Chem.*, 47, 10, 2122 (Oct. 1955).

Nylon and Dacron fibers require substantial quantities of aromatic chemicals as their raw materials, and are believed to hold promise for expansion. Polyesters in film form, such as Mylar and Cronar, are so new that their present needs are overshadowed by the fiber requirements.

"Epoxy Casting Resins," H. Jahn and W. Schafer, *Plaste u. Kautschuk*, 2, 10, 224 and 2, 11, 252 (Oct. and Nov. 1955).

At the plastics laboratory of the German Academy of Sciences, Berlin, four types of epoxy casting resins have been developed. AG-1, a heat hardening resin, solid at slightly above room temperature, which has softening point of 40-50° C., and is processed together with an acid hardener AH-1. The mixture is liquid at 130-140° C. and can be cast in open molds, the resin hardening at 100-200° C. without pressure to form a bubble-free, transparent, rigid plastic of a yellowish to slightly brownish color. AG-11, AG-12, and AG-13 are viscous resins obtained from AG-1 by mixing with reactive diluents which carry definite functional groups and react with the resin molecule during the hardening process. AG-1 is intended solely as casting resin, while the others also serve as laminating resins. Methods of processing are described, and properties are compared with those of filled and unfilled phenolics, rigid PVC, and glazed porcelain. Various applications are mentioned, and use as materials for stress optics investigation is suggested. Experimental quantities of the resins are to be made available to manufacturers for testing. (In German).

"Oxygen Uptake of Polyethylene at Elevated Temperatures," Joseph E. Wilson, *Ind. Eng. Chem.*, 47, 10, 2201 (Oct. 1955).

Oxygen uptake measurements on polyethylene at one-atmosphere pressure show the reaction to have a pronounced induction period, followed by a constant-rate stage and ultimate decrease. Antioxidants increase the induction period, and rates should be made proportional to sample mass rather than surface area.

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines will be printed here quarterly.

The next complete listing will appear in June.

—The Editor

"Photosensitizers for Polyester-Vinyl Polymerization," Chester M. McCloskey and John Bond, *Ind. Eng. Chem.*, 47, 10, 2125 (Oct. 1955).

Photopolymeriation of vinyl monomers and allyl halides offers certain advantages over thermal polymerization, especially in applications requiring long pot life and rapid, low-temperature gelling. The photoactivity of several photosensitizers is explored, including the variations produced by changes in their concentration.

"Epoxy Esters as Plasticizers and Stabilizers for Vinyl Chloride Polymers," Leo P. Witnauer, H. B. Knight, W. E. Palm, R. E. Koos, W. C. Ault, and Daniel Swern, *Ind. Eng. Chem.*, 47, 11, 2304 (Nov. 1955).

Compatibility of long-chain fats with PVC can be increased by introducing the oxirane ring into the molecule. This is accomplished by epoxidizing the unsaturated fatty materials with organic peracids. A number of epoxy esters were investigated, and properties of the finished polymers were evaluated, especially with respect to plasticizer volatility and migration.

"Surfactant-Treated Minerals as Reinforcing Fillers," Alan S. Michaels, *Ind. Eng. Chem.*, 48, 2, 297 (Feb. 1956).

Mineral fillers such as kaolinite and wollastonite were treated with fatty quaternary ammonium salt and fatty amine surfactants. The physical properties of resinous and elastomeric compositions containing these fillers were evaluated, and shown to be superior in abrasion resistance and strength. In addition, due to improved resin distribution, more filler could be added without appreciable loss in resiliency.

"Contributions to the Analytical Chemistry of Plastics. III. Analysis of Polyesters from Terephthalic Acid," E. Schroder and K. Thinius, *Plaste u. Kautschuk*, 2, 11, 245 (Nov. 1955).

Processes are described for analyzing polyglycol terephthlate by the potassium ethanolate method, and by depolymerizing with ethanolamine to terephthalic acid-bis-2-oxyethylamide. The bis-2-oxyethylamide could not be quantitatively separated, but a method of identifying it by melting point was worked out. Aminolysis, it is added, proved to be the more rapid method, but it is difficult to recognize the end of the reaction. (In German).

"Plasticized Phenol Resins," Kosatik, *Plaste u. Kautschuk*, 2, 11, 246 (Nov. 1955).

At the Research Institute for Synthetic Resins, Pardubice, Czechoslovakia, resols of tri-functional phenols with improved solubility and mechanical properties were obtained by etherification of the resols with butanol in the presence of drying oils, particularly wood oil. The etherified, oil-modified products are said to be soluble in almost all organic solvents, including drying oils. (In German).

"Production of Vinyl Polymers by Ionizing Irradiations," A. Chapiro, M. Magat, J. Prevot-Bernas, Reiniser, and Sebhan, *Ind. Plastiques Mod.*, 7, 10, 44 (Dec. 1955).

On the basis of earlier findings, the authors discuss certain aspects of polymerization by irradiation on an industrial scale. The observation that the rate of polymerization increases as the square root of the intensity of irradiation suggests the use of several sources of lower intensity instead of a single powerful source, the gamma rays of radioactive cobalt being preferred. At 20° C. with a single source of 40 Curies of radioactive cobalt, one ton of methyl methacrylate can be produced in a year, with an average molecular weight from 350,000-450,000, according to the radius of the cylindrical container. With four sources of 40 C. each, production also is one ton per year, and half the amount will have a molecular weight of 250,000, the minimum for the rest being 180,000 and the maximum 330,000. With a central source of 400 C., production in the same container would be 2.3 tons annually. The advantages of irradiation over photochemical polymerization are stated. One of the advantages of irradiation over catalytic polymerization is the range permitted in choice of temperature. (In French).

"Polymerization," A. F. Roche, *Ind. Eng. Chem.*, 47, 9, Part II, 1903 (Sept. 1955).

A four-part review of the unit process of polymerization, this article covers processes and equipment, catalysts and inhibitors, chemistry of polymerization, and other interesting polymers. An extensive bibliography is included.

"Intermediate for Flame-Resistant Polymers," Wilson A. Reeves and John D. Guthrie, *Ind. Eng. Chem.*, 48, 1, 64 (Jan. 1956).

Flame-resistant polymers made by reacting tetrakis (hydroxymethyl) phosphonium chloride with urea, melamine, phenol, etc., are expected to serve many industrial uses. This paper describes the reactions with amines, phenols, and polybasic acids and anhydrides to produce polymers, as well as a number of experimental polymerization reactions.

"Glycidyl Ether Reactions with Amines," Leon Shechter, John Wynstra, and R. B. Kurkjy, *Ind. Eng. Chem.*, 48, 1, 94 (Jan. 1956).

A study of the chemistry of cure of epoxy resins by amine hardeners showed that: (1) the aliphatic amine-glycidyl ether reaction was very rapid, but influenced by steric factors; (2) aromatic amines were much less reactive; and (3) hydroxyl groups generated during the reaction markedly accelerated the amine-glycidyl ether reaction. The hydroxyl groups served only as catalysts for the reaction. A mechanism explaining this catalytic effect is proposed.

"Internal Pressure Distribution in Molding Phenolic Test Bars," J. M. Rausch and W. Orvis, *SPEJ*, 12, 1, 24 (Jan. 1956).

The strain-gage pressure measuring technique has been applied satisfactorily to the measurement of internal pressures developed in a semi-transfer test bar mold by both one- and two-stage general-purpose phenolics. Only a narrow range of molding conditions has been investigated thus far, and an extension of the method to broaden the range of temperatures, pressures, etc., is expected to yield valuable results in establishing optimum molding conditions for optimum physical properties.

"Empirical Study of Slow-Flexing, Special Case of Lucoflex," J. Lesavre, *Ind. Plastiques Mod.*, 7, 10, 41 (Dec. 1955).

It was attempted to find a formula linking the distance of the supports (in a flexing test) to the thickness and size of the test bar, so that the value obtained for resistance to bending is always the same. The two types of mathematical formulas were tested and compared, and one was found to be acceptable. The most sitable cutter speed in tests on Lucoflex was 10 mm./min. It was further observed that the duration of the test is approximately proportional to the thickness of the sample. (In French).

"Glycidyl Ether Reactions with Alcohols, Phenols, Carboxylic Acids, and Acid Anhydrides," Leon Shechter and John Wynstra, *Ind. Eng. Chem.*, 48, 1, 86 (Jan. 1956).

Different routes in the reactions were estimated by means of model compound reactions and analytical procedures. Noncatalyzed, these reactions required temperatures of 200° C. or higher to proceed at reasonable rates. With the addition of a base catalyst, the reactions are accelerated considerably, while with acidic reactants they become highly selective. A generalized reaction mechanism suggested by these results is proposed.

"Ultrasonic Waves as a Measure of Cure," A. G. H. Dietz, E. A. Hauser, F. J. McGarry, and G. A. Sofer, *Ind. Eng. Chem.*, 48, 1, 75 (Jan. 1956).

A discussion of various factors involved in the method of following the cure of polyesters, phenol-formaldehyde, and related resins by means of ultrasonic waves.

"Reaction and Cure in Melamine Plastics," H. P. Wohnsiedler, I. H. Updegraff, and R. H. Hunt, Jr., *Ind. Eng. Chem.*, 48, 1, 82 (Jan. 1956).

Optimum properties of melamine resins and other plastics can be realized when the relationship of particular properties to cure is known. Results are given for the measurement of degree of reaction over a broad range of cures. Heat distortion, flexural strength, and water absorption reach their optimum values at different degrees of reaction, whereas modulus of elasticity undergoes little or no change with degree of reaction. Degree of polymerization and polymer structure are also related to degree of reaction, but a number of interpretations of this relationship can be made.

"Cross Linking of of a Phenol-Formaldehyde Novolac," M. F. Drumm, C. W. H. Dodge, and L. E. Nielsen, *Ind. Eng. Chem.*, 48, I, 76 (Jan. 1956).

Details of the method and results obtained with the dynamic-mechanical measurement technique for studying the degree of cross-linking of phenol-formaldehyde novolacs with hexamethylenetetramine. The percentage of cross-linking agent, the cure temperature, and the cure time are shown to affect cross-linking in that order of significance.

"Degree of Cure in Thermosetting Resins," Eugene Barr, *Ind. Eng. Chem.*, 48, 1, 72 (Jan. 1956).

The reasons for the commercial success of phenolics, ureas, melamines, alkyds, unsaturated polyesters, silicones, epoxies, and polyester rubber are explained. Information is given on how these materials differ in cure. Definitions of cure are presented, together with presently-known methods of measuring degree of cure. These techniques leave much to be desired, and the importance of precision measurement of degree of cure is stressed.

Processing

"Heat Bonding of Teflon Tetrafluoroethylene Resin," P. J. Wayne and W. M. Bruner, *SPEJ*, 11, 10, 28 (Dec. 1955).

A description of thickness requirements, joint surfaces for bonding, flux, heaters and heater presses, toxicology of the plastic, and related information for the heat bonding of Teflon used in corrosion-resistant process equipment.

Applications

"Plastics, Resins and Paints," Lloyd E. Parks, *SPE. J.*, 11, 10, 19 (Dec. 1955).

A discussion of plastic compositions and properties, and their effects on paint formulations for decorating these plastics.

General

"Plastics," Raymond B. Seymour, *Ind. Eng. Chem.*, 47, 9, Part II, 2011 (Sept. 1955).

A general report on plastic products and materials for the year 1954, this report covers thermoplastic pipe, reinforced plastics, plastic structures, cellular plastics, vinyls, polyethylene, polyesters, epoxies, furan and phenolic resins, polyfluorocarbons, styrenes, and silicones. An extensive bibliography is included.

Patent Digest

Materials

Copolymers of Vinyl Esters of Stabilized Rosin Acids with Vinyl Esters of Fatty Acids and Process Therefor. No. 2,727,-872. Walter S. Ropp, Wilmington, Del. (to Hercules Powder Co., Wilmington, Del.).

The saturated fatty acid used in the reaction contains 12-18 carbon atoms, and the chemically-stable rosin acid contains not more than 10% rosin acids with the carbon skeleton of abietic acid. It also contains two ethylenic double bonds per molecule.

Nitrocellulose Coating Composition. No. 2,729,571. J. D. Brandner and R. H. Hunter, Wilmington, Del. (to Atlas Powder Co., Wilmington, Del.).

A nitrocellulose lacquer, the solids of which consist essentially of one part by weight of soluble nitrocellulose containing from about 10.7-12.2% nitrogen; from about 0.25-1.0 part of phenoxyethyl tall oil ester as plasticizer; and from 0-5 parts of a modifying resin.

Plastic Welding Composition. No. 2,729,-573. B. B. Goldner, Philadelphia, Pa., and J. C. MacIntyre, Lansdale, Pa.

A composition of matter used as a plastic weld consisting of a mixture of ethylene dichloride and tetrahydrofurfuryl alcohol.

Modification of Polyester Bodies. No. 2,730,517. H. A. Vogel and A. R. Bader, Milwaukee, Wisc. (to Pittsburgh Plate Glass Co.).

A modified alkyd resin obtained by interesterification of an alkyd body containing free hydroxyls and an ester of a beta-keto acid and a monohydric alcohol containing 1-4 carbon atoms.

Phenol-Formaldehyde Resins Esterified with Higher Unsaturated Fatty Acids and Dimerized Rosin. No. 2,730,511. D. E. Floyd, Robbinsdale, Minn. (to General Mills, Inc.).

A p-t-butylphenol formaldehyde resin esterified with a mixture of an unsaturated higher fatty acid and dimerized rosin, the resin being esterified at least 50% and the dimerized rosin constituting from 10-50 equivalent percent of the acids esterified.

Urea Formaldehyde Condensation Product. No. 2,729,611. L. C. Chesley, Jr., Syracuse, N. Y., and R. G. Hart, Bainbridge, N. Y. (to The Borden Co., New York, N. Y.).

To make a resin that gives a stable colloidal solution in water, the process comprises warming a mixture of about 1.4-1.9 mols of formaldehyde with one mol of urea in aqueous solution and at a pH of at least 7, continuing the warming only until condensation reaches the stage at which dimethylol urea is formed and a specimen of the solution shows a positive cloud test upon cooling, then adding additional formaldehyde in amount to make the total formaldehyde introduced about 2.1-3 mols, adding an acid catalyst of urea formaldehyde condensation to make the pH approximately within the range of 2.5-6, and continuing the warming until the product gives a colloidal solution with a strong Tyndall effect.

Manufacture of Polymerization Products Obtained from Acrylic Acid Derivatives. No. 2,729,615. G. I. M. Bloom, Knebworth, J. E. Duddington, St. Albans, M. F. Vincent, Harpenden, and A. H. Willbourn, Welwyn Garden City, England (to Imperial Chemical Industries, Ltd., London, England).

Polymerizing an ester of alpha-chloroacrylic acid in the presence of a compound containing an epoxy group selected from the group consisting of ethylene oxide, propylene oxide, epichlorohydrin, phenyl glycidyl ether, diallyl ether monoxide, and poly-diallyl ether monoxide.

Titanium Tetrafluoride as Catalyst in Production of Polyesters. No. 2,729,619. J. K. Sullivan, Akron, O. (to Goodyear Tire & Rubber Co., Akron, O.).

Preparing a polyester by the self-condensation, with the removal of glycol, of a bis-glycol ester of at least one acid selected from the group consisting of terephthalic acid and isophthalic acid, the improvement which comprises carrying out said condensation in the presence of a catalytic amount of titanium tetrafluoride.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.
—The Editor

Neodymium Chloride as Catalyst in Production of Polyesters. No. 2,729,620. J. K. Sullivan, Akron, O. (to Goodyear Tire & Rubber Co., Akron, O.).

Same as Patent No. 2,729,619, except that neodymium chloride is used as the catalyst instead of titanium tetrafluoride.

Condensation of Urea and Formaldehyde. No. 2,729,616. M. H. Bigelow and H. N. Spurlock, Toledo, O. (to Allied Chemical & Dye Corp., New York, N. Y.).

A method that comprises the steps of bringing urea, formaldehyde, and water together to form an aqueous solution containing not less than 1.5 nor more than 2.5 mols of formaldehyde per mol of urea, adjusting the pH of the solution to between 6-8, subjecting the solution to superatmospheric pressure, heating the solution to a temperature above its boiling point at atmospheric pressure to thereby cause the pH to drop to a value at which condensation proceeds, and arresting the condensation at the desired point by cooling the solution.

Polymerization of DL-Alanine Carboanhydride and Orientation of Polymer. No. 2,729,621. R. E. Miegel, Elsmere, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Process of preparing an oriented high molecular weight, linear polyamide, the recurring units of which are DL-alanine units. The polyamide resulting from the polymerization has an inherent viscosity of at least 0.3, and is oriented by stretching at least 200%.

Polymerization of Vinyl Monomers by Oxyhalogen Acid Anion/Hydrazine Disulfonate Ion Compositions. No. 2,720,624. E. G. Howard, Jr., Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Polymerization of a monomer subject to addition polymerization and containing a carbon-carbon double bond which comprises bringing said monomer in contact in an aqueous system with a water-soluble hydrazine disulfonate and an oxidizing agent of the class consisting of water-soluble bromates, iodates, and periodates.

Cross-Linked Copolymers of the Esters of Acrylic and Methacrylic Acid. No. 2,729,625. M. D. Hurwitz, Huntingdon Valley, Pa. (to Rohm & Haas Co., Philadelphia, Pa.).

A thermoplastic copolymer which is capable of converting to a thermoset product when heated above about 135° C., and which is the copolymerized product of a mixture of three essential components: (1) from 5-15 molar percent of an ester; (2) from 5-15 molar percent of another ester; and (3) from 70-90 molar percent of at least one ester having the general formula $CH_2=CRCOOR'$, in which R is a member of the class consisting of a hydrogen atom and the methyl radical, and R′ is a non-tertiary alkyl radical containing 1-18 carbon atoms.

Polyvinyl Chloride for Use in Plastics. No. 2,729,627. C. I. Carr, Jr., Fair Lawn, N. J. (to United States Rubber Co., New York, N. Y.).

Making PVC for use in plastisols by a method comprising polymerizing an aqueous emulsion of vinyl chloride to a desired final conversion of monomeric vinyl chloride to polymer of 50-95% at a temperature from 40-60° C. to form a latex having an average particle diameter from 0.35-0.9 micron, and at the time between 50-95% of the desired final conversion adding to the reaction mixture a molecular weight regulator for PVC selected from the group consisting of polyhaloalkanes, polyhaloalkenes, alkyl aldehydes, ethyl dibromoacetate, ethyl dibromomalonate, benzene sulfonyl chloride and its monomethyl and monohalo derivatives, 1,1,1-tribromo-2-methyl proponal-2, allyl bromide, n-chlorophthalimide, alkyl iodides, and phenacyl bromide, in effective amount to give a final polymer having an intrinsic viscosity of 0.75-1.3 measured in cyclohexanone at 30° C. After final conversion of vinyl chloride to polymer, removing any unreacted residual vinyl chloride monomer and recovering the PVC from the latex.

Equipment

Molds for Making Dolls Composed of Plastic Material. No. 2,728,947. J. L. Kallus, New York, N. Y.

A mold for a doll's head having two small chambered spherical eye-forming metal wall portions, each having a restricted small opening, and a large chambered head-forming metal wall portion having a restricted main opening at the neck portion of the doll's head and extending into and completely covering the inner faces of the eye-forming wall portions, said large metal wall portion metallically secured to the entire inner faces of the small chambered wall portions with its inner face forming the outer conformation of the doll's head including the doll face, and with the small chambered wall portions extending inwardly from the large chambered portion and their outer faces forming deep bulging eye sockets in the doll's head.

Molds for Making Dolls Composed of Plastic Material. No. 2,728,948. J. L. Kallus, New York, N. Y.

A mold having a metal wall forming a chambered doll head and a restricted neck portion with a main opening at the entrance to the neck portion and two small openings defining locations for eye conformations in said wall adjacent said openings having inwardly facing concave faces to form seats; position-defining preformed bulbous eye socket-forming metal protuberances positioned on said seats to form eye sockets; anchoring devices engaging the outer face of said wall; and bolts extending through the openings in said metal wall, through said metal parts and said anchoring devices to secure said metal parts in place. Each metal protuberance has a greater main diameter than the diameter of its associated opening.

Extrusion Apparatus. No. 2,728,943. D. B. Hertz and Ho Chow, New York, N. Y. (to Celanese Corp. of America, New York, N. Y.).

In an extrusion apparatus, the combination with an extruder and a forming die of a body portion having a passageway into the inlet end of which the extruded material enters from the extruder, and from the outlet end of which the extruded material enters into the forming die; said body portion having a bore, a plug positioned in said bore, and a passageway extending therethrough that is aligned with the passageway in the body portion to form a path for the extruded material; said plug and said bore having interengaging tapered surfaces that form a seal when the plug is seated in the bore; and a filter assembly positioned in the passageway in the plug for filtering the extruded material. The plug carrying the filter assembly is constructed and arranged for ready removal and replacement.

Production of Artificial Films. No. 2,728,944. C. H. Crooks, Welwyn, England (to Imperial Chemical Industries, Ltd., London, England).

Apparatus for the production of melt-extruded film which comprises a pair of contra-rotatable nip rolls, means for extruding a molten film downwards into the nip of these rolls, means for supplying liquid to the nip and for maintaining a pool of liquid therein, and means for removing liquid from the pool at each side of the film path (said means being in the regions directly between the film path and the nip rolls).

Processing

Process for Producing Fibers from Films of Polymeric Materials. No. 2,728,950. R. J. Annesser, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

The method comprises supplying a coherent and unoriented plastic film to the nip between a cold roll having a yieldable surface and a heated roll having closely spaced parallel narrow circular ridges on its periphery, while applying sufficient pressure to the latter roll to score the film to at least half its thickness, stretching the scored film to effect longitudinal orientation, and mechanically separating the stretched product into fibers along the scored lines.

Process for Quenching Melt Extruded Film. No. 2,728,951. A. F. O'Hanlon, High Salvington, and J. W. Cornforth, Harpenden, England (to Imperial Chemical Industries, Ltd., London, England).

Process for quenching a melt-extruded film of a highly polymeric synthetic linear compound which comprises passing the film downwards in its molten state into a pool of liquid maintained in the nip formed between two contra-rotating rolls. Said liquid is maintained at a temperature considerably below its boiling point, and is of sufficient quantity and depth and sufficiently below the melting point of the polymeric compound to cause rapid chilling of the film to the solid state. The two rolls are rotated at equal peripheral speeds, and each roll at the nip rotates in the direction of travel of the quenched film.

Method of Making Films. No. 2,728,952. M. J. Borushko, Detroit, Mich. (to Harding Mfg. Co., Inc., Detroit, Mich.).

A method of making a continuous film which comprises providing a body of a liquid composition including a solvent and a film-forming material dispersed therein; maintaining said liquid at an elevated temperature approaching the boiling point of the solvent; condensing the solvent vapor before it reaches a predetermined level above the surface of the liquid; and returning this condensate to the liquid; enclosing the space immediately above this level and cooling this space to maintain it at a solvent vapor condensing temperature; providing an endless body capable of absorbing, retaining, and releasing heat; advancing said body over an endless path which extends into and out of the liquid, through the vapor-containing zone, through the vapor-free zone, and back into the body of liquid. The film formed on this body is then separated from the body.

Prevention of Nylon Gel Formation. No. 2,729,538. D. R. Hull, Seaford, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

A process for forming a polyamide fiber by coating with a silicone those internal surfaces of a melt spinning device which are ahead of the metering pump and which during conventional operation of the spinning device contact molten polyamide, thereafter introducing molten polyamide, extruding the melt through an orifice, and solidifying the extruded mass into a fiber.

Process for Adhering Polyvinyl Chloride Containing a Softener to a Non-Metallic Layer. No. 2,729,585. Wolfgang Gruber, Joseph Heckmaier, and Martin Doriat, all of Burghausen, Germany (to Wacker-Chemie G.m.b.H.).

Process for adhesively joining two layers of non-metallic materials, at least one of which comprises PVC containing a softener which normally impairs its adhesiveness. To this softener-containing layer is affixed a facing selected from the group consisting of pure PVC and a copolymer of vinyl chloride and vinyl acetate, and this facing is then adhesively united with the other layer of material.

Process for Polymerizing Monomeric Aromatic Vinyl Compounds. No. 2,729,-610. Heinz Ehring, Krefeld, Germany, and Karl Raichle, Krefeld-Uerdingen, Germany (to Farbenfabriken Bayer Aktiengesellschaft, Leverkusen, Germany).

Process for polymerizing a monomeric aromatic vinyl compound selected from the group consisting of vinyl naphthalene, styrene, alpha-alkyl styrenes, and styrenes substituted in the nucleus by a group of the class consisting of an alkyl group, a hydroxy group, an alkoxy group, and a halogen group, in the presence of an ester of a polyvalent alcohol containing a radical of a higher unsaturated fatty acid. The liquid reaction mixture is rapidly circulated and recirculated through a predetermined path in a closed system comprising an elongated narrow zone. The monomeric aromatic vinyl compound is gradually introduced into the liquid phase of the ester substantially before the end of the narrow zone.

Method and Apparatus for Making Fiber Glass Pipe. No. 2,731,067. R. G. Miller, Bayside, N. Y. (to East Coast Aeronautics, Inc., Mt. Vernon, N. Y.).

The method for manufacturing reinforced thermosetting resin pipe comprises the forming of a continuous cylindrical mandrel, winding this mandrel with strands of fiber glass all lying at an angle of about 63.4° to all planes laying in the axis of the mandrel, enclosing the wrapped mandrel in a layer of thermosetting resin in fluid state, hardening said resin to produce the finished pipe, cutting said pipe and mandrel into axial sections, and removing the mandrel sections from the pipe sections.

The apparatus includes a plurality of cylindrical mandrel sections; means for connecting these sections end-to-end (these means comprising disposable bushings having end portions adapted to fit into the ends of adjoining mandrel sections and a central cylindrical portion separating the end faces of adjoining mandrel sections); means for moving the connected mandrel sections longitudinally on the mandrel axis; means adjacent the connected mandrel sections for winding filamentary fiber glass around them as they move longitudinally; means in the path of the wound mandrel sections for impregnating them with resin; means for hardening said resin to form a continuous pipe; means for severing said pipe into sections; and means for separating each pipe section from the mandrel on which it was wound.

Current Market Prices

Price Changes and Additions

Adhesives

Synvarite US #1	lb.	.195 / .215
Synvarol T	lb.	.125 / .16
T-3	lb.	.0875/ .1225
T-15, T-15D	lb.	.1275/ .1625
TN, TUN	lb.	.1325/ .1675
TN-23	lb.	.14 / .175
WR-513	lb.	.0875/ .1225
WR-515	lb.	.0825/ .1175
WR-520	lb.	.0625/ .0925

Colors

Claremont PX-Series Pastes:		
1778 Bright Silver	lb.	1.45 / 1.55
1781 Light Grey	lb.	1.30 / 1.40
1786 Medium Red	lb.	3.05 / 3.15
1788 Mahogany Brown	lb.	1.08 / 1.18
2034 Plastic White	lb.	.91 / 1.01
2208 Permanent Black	lb.	1.58 / 1.68
2502 Glass Green	lb.	2.76 / 2.86
2514 Primrose Yellow	lb.	2.05 / 2.15
2515 Rust Brown	lb.	1.37 / 1.47
2516 Plastic Blue	lb.	2.50 / 2.60
2522 Plastic Yellow	lb.	2.45 / 2.55
2523 Dark Red (Cadmolith)	lb.	3.85 / 3.95
2524 Orange	lb.	1.48 / 1.58
2537 Claret Red	lb.	2.25 / 2.35
2538 Golden Yellow	lb.	2.05 / 2.15
2546 Ochre	lb.	1.27 / 1.37
Plastics Color Co:		
Blacks	lb.	.75 / 3.80
Blues	lb.	.65 / 3.50
Brown	lb.	1.20 / 2.25
Greens	lb.	.65 / 3.50
Reds	lb.	.65 / 3.50
Whites	lb.	.75 / 1.10
Yellows	lb.	1.15 / 1.95

Coating Resins

Synvaren 631	lb.	.175 / .21
PLS-1	lb.	.445 / .48
PLS-2	lb.	.41 / .445
PLS-22	lb.	.405 / .44
PLS-A	lb.	.56 / .595
PLS-AA	lb.	.735 / .77
PLS-R	lb.	.765 / .80
Synvarite BRLD	lb.	.40 / .41

Glass Reinforcements

Chrome 60-end Roving:		
FBF-7.1, -7.3	lb.	.40 / .44
FBF-7.5, -7.7	lb.	.42 / .46
Garan 60-end Roving:		
FBF-7.2, -7.4	lb.	.42 / .46
FBF-7.6, -7.8	lb.	.44 / .48
Vitron 60-end Roving:		
VR-12	lb.	.48 / .52

Plasticizers

Polycon #7, 9, 10, 11	lb.	.305 / .335
#30	lb.	.30 / .33
#31	lb.	.27 / .30
#40	lb.	.245 / .275

Resins & Molding Compounds

Phenolic		
Synvar molding compounds:		
PM-6443, -6444, -6446, -6447, -6449, -6494, -6512, -6516, -6593, -6594, -6596, -6598, -6599, -56502, -56512	lb.	.19 / .205
PM-76925	lb.	.205 / .215
PM-86446, -86516	lb.	.2425/ .2525
PM-86513	lb.	.245 / .255
PM-86517	lb.	.37 / .38
Synvaren 640	lb.	.245 / .28
920	lb.	.21 / .255
935	lb.	.185 / .21
9203	lb.	.168 / .203
Synvaren liquid industrial resins:		
615	lb.	.2425/ .2775
673X	lb.	.25 / .275
675	lb.	.285 / .32
917	lb.	.27 / .295
920	lb.	.21 / .255
924	lb.	.385 / .42
38100	lb.	.31 / .345
CP-66	lb.	.185 / .22
PBL-2	lb.	.32 / .355
PBL-218S, -919	lb.	.265 / .30
PBL-911-I	lb.	.30 / .325
Synvarite GW-1000, PBL-410, P-14Y, PNL-12 PD	lb.	.32 / .34
GW-1080, PBL-108F, PBL-718	lb.	.36 / .38
GW-1330	lb.	.45 / .47
GW-1600, PBL-108FF	lb.	.37 / .39
GW-2400	lb.	.365 / .385
GW-7311	lb.	.535 / .555
PBL-100	lb.	.30 / .32
PBL-210, PBL-3301	lb.	.35 / .37
PBL-218, PNL-12H, RC-420	lb.	.33 / .35
PBL-731	lb.	.425 / .445
PBL-3311, PNL-161 PD	lb.	.34 / .36
PNL-12, PNL-355H	lb.	.315 / .335
PNL-12HL, PNL-156HL	lb.	.2925/ .3125
PNL-156	lb.	.335 / .355
PNL-156H	lb.	.345 / .365
PNL-160H/2	lb.	.31 / .33
PNL-161H	lb.	.35 / .37
PNL-169H, -169HL	lb.	.28 / .30
PNL-169 PD	lb.	.27 / .29
PNL-355 PD	lb.	.305 / .325
PNL-355HF	lb.	.325 / .345
PNL-1277HL, -1278HL, -1279HL	lb.	.2775/ .2975
POS-50	lb.	.40 / .42
POS-56	lb.	.41 / .43
PT	lb.	.295 / .305
RC-244	lb.	.385 / .405
Urea		
Beetle C-4980 Brown	lb.	.1875/ .30
No fines granulation	lb.	.2075/ .32
T-298 Black	lb.	.1875/ .30
Vinyls		
Geon Latex 151, 251	lb.	.26 / .32
351	lb.	.32 / .38
3??	lb.	.28 / .34
552, 652	lb.	.37 / .43
450x167	lb.	.39 / .45
576	lb.	.365 / .405

Positions Open

Display Rates $10.00 per Inch

VINYL COMPOUNDING

Young plastic Chemist or Engineer wanted for development of vinyl extrusion and molding compounds and production control, Metropolitan New Jersey. Will also consider part time. State experience, salary desired. Replies will be held in strictest confidence. Reply to Box 56,

PLASTICS TECHNOLOGY

386 Fourth Avenue, New York 16, N.Y.

WANTED—INJECTION MOLDING FOREMAN

Modern plant, seven machines, Brooklyn. Good opportunity for thoroughly experienced foreman. Also opening for assistant foreman. Reply Box 57

PLASTICS TECHNOLOGY

386 Fourth Avenue, New York 16, N.Y.

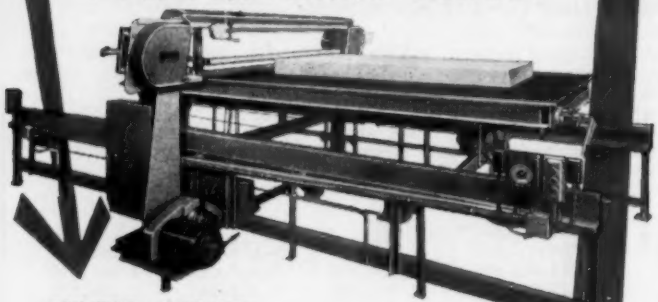
Domestic Production and Sales of Plastics and Resin Material, 1955 Totals and January, 1956

Following are the preliminary 1955 totals and the estimated January, 1956 statistics for domestic production and sale of plastics and resinous materials. Units listed are in pounds, dry weight, unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily restricted to the protective coating industry. Compared with 1954, cellulosics show a 17% gain; phenolics, 20%; urea and melamines, 15%; styrene, 20%; vinyls, 35%; coumarone-indene, 18%; and other resins (including polyethylene and polyesters) show an almost 100% increase.

	Preliminary Totals, 1955		January	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	18,800,839	18,917,556	1,487,069	1,461,819
Sheets, 0.003 gage and over	15,854,838	15,105,450	1,314,344	1,200,490
All other sheets, rods, and tubes	7,646,170	7,226,855	706,607	585,947
Molding and extrusion materials	91,716,464	90,120,865	6,491,894	6,413,458
Nitrocellulose sheets, rods, and tubes	4,868,874	5,100,383	518,768	514,008
Other cellulose plastics	5,868,788	5,430,702	450,274	327,932
TOTAL	144,755,973	141,901,811	10,968,956	10,503,654
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	211,240,431	195,629,777	19,714,593	17,635,473
Bonding and adhesive resins for—				
Laminating (except plywood)	68,545,865	50,959,332	5,981,360	3,913,192
Coated and bonded abrasives	15,327,947	16,079,304	1,510,004	1,473,003
Friction materials (brake linings, clutch facings, and similar materials)	25,231,671	22,084,336	1,940,983	1,592,237
Thermal insulation (fiber glass, rock wool)	52,452,833	52,395,493	5,173,179	4,788,116
Plywood	44,336,096	36,226,501	3,479,067	2,845,914
All other bonding and adhesive uses	27,641,456	26,752,633	2,726,120	2,720,703
Protective-coating resins, unmodified and modified except by rosin	27,786,651	24,637,769	2,743,116	2,494,781
Resins for all other uses	32,999,586	28,830,859	2,881,562	2,564,078
TOTAL	505,562,536	453,596,004	46,149,984	40,027,497
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	42,202,277	41,133,524	4,263,135	4,205,728
Paper-treating and paper-coating resins	23,673,663	22,470,415	2,209,455	1,930,055
Bonding and adhesive resins for—				
Plywood	97,760,888	92,119,167	8,767,636	7,916,795
All other bonding and adhesive uses, including laminating	28,064,547	27,617,997	3,397,389	2,396,953
Protective-coating resins, straight and modified	38,410,276	29,678,373	3,287,329	2,457,688
Resins for all other uses, including molding	82,792,959	80,057,749	7,773,867	7,898,754
TOTAL	312,904,610	293,077,225	29,698,811	26,805,973
Styrene Resins:				
Molding materials[1]	422,141,923	380,809,717	38,597,258	33,049,888
Protective-coating resins, straight and modified	101,711,620	92,800,352	9,810,843	7,764,615
Resins for all other uses	86,372,669	85,088,680	8,404,915	8,257,215
TOTAL	610,226,212	558,698,749	56,813,016	49,071,718
Vinyl and Vinyl Chloride Resins:[3]				
Polyvinyl chloride and copolymer resins (50% or more PVC)for—				
Film (resin content)		83,277,823		8,022,011
Sheeting (resin content)		51,423,444		4,928,499
Molding and extrusion (resin content)		183,736,804		16,842,315
Textile and paper treating and coating (resin content)[4]		64,209,544		6,176,010
Flooring (resin content)		56,356,346		5,180,595
Protective coatings (resin content)		26,503,295		2,288,852
All other uses (resin content)		59,654,138		6,584,001
All other vinyl resins for—				
Adhesives (resin content)		31,808,136		3,330,827
All other uses (resin content)		106,585,972		10,628,175
TOTAL	701,664,676	663,555,502	67,500,340	63,981,285
Coumarone-Indene and Petroleum Polymer Resins	259,632,089	257,714,861	21,251,310	20,151,131
Polyester Resins:				
For reinforced plastics	51,824,505	44,501,478	4,162,679	3,464,948
For all other uses	3,212,576	2,596,388	1,179,690	1,068,502
TOTAL	55,037,081	47,097,866	5,342,369	4,533,450
Polyethylene Resins	420,191,117	345,536,673	42,888,582	40,067,722
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1] [4]	50,909,069	46,952,519	3,920,716	3,394,256
Protective-coating resins[5]	4,197,258	2,660,881	650,519	391,742
Resins for all other uses[6]	81,803,102	77,783,279	10,215,079	9,149,564
TOTAL	136,909,429	127,396,679	14,786,314	12,935,562
GRAND TOTALS	3,146,883,723	2,888,575,370	295,399,682	247,926,861

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
SOURCE: United States Tariff Commission, Chemical Division.

Here's Our New Machine that Levels and Cuts POLYURETHANE SLABS!



SLICES MOST STOCK INTO SHEETS AS THIN AS 1/16 INCH

Yes, with FEMCO'S new Polyurethane Leveling and Splitting machine you can easily reduce bulky polyurethane into thin sheets. Save by buying slab polyurethane and fabricating it yourself. And this one-man operated machine is a real labor saver, too!

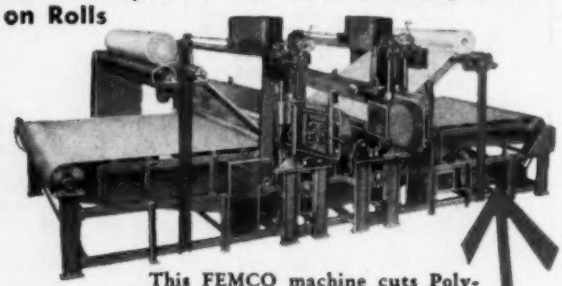
"PUSH BUTTON" OPERATION

After machine levels the slab, operator, from "unload" position, pushes a button. The table glides back and forth and the cutting blade does the rest. The table automatically raises and lowers to clear the cutting blade on the backward movement, then indexes to required thickness before the forward movement.

Available in these table sizes: 45" x 64"; 45" x 84"; 64" x 84"; 64" x 96"; 84" x 110".

Wire, write, or call for details.

DOUBLE-HEAD POLYURETHANE SLAB-CUTTER Splits Stock Into Sheets, Winds on Rolls



This FEMCO machine cuts Polyurethane slabs into sheets (1/16" if desired) and then winds the sheets into rolls, easy to ship or fabricate. Handles slabs 84" wide and 25 feet long *(to 100 feet long when power conveyors are added.)*

With the "two-way" or double-head action of the cutter, stock is cut on both forward and backward movements of the conveyor belt; cutter automatically indexes to meet the stock, which is rolled up at each end of the machine. A slab of polyurethane may be split and rolled in minutes. Wire, write, or call us for details and photos.

The FALLS ENGINEERING AND MACHINE CO.

1734 FRONT ST. CUYAHOGA FALLS, OHIO

CALENDAR of COMING EVENTS

May 14-17
Design Engineering Show, Philadelphia, Pa.

May 16
SPE New York Section, Gotham Hotel, New York City

May 21
SPE Southern Section, Mammy's Shanty, Atlanta, Ga.

May 21
SPE Upper Midwest Section's Plastic Fair

May 23
SPE Philadelphia Section, Franklin Institute, Philadelphia, Pa.

June 6
SPE Western New England Section, Bradley Field, Windsor Locks, Conn.

June 7
SPE Southern California Section, Scully's Restaurant, Los Angeles, Calif.

June 11-15
SPI Seventh National Plastics Exposition & Technical Conference, Coliseum, New York City

June 17-22
ASTM Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

June 26
SPI Plastic Structures Division Conference, Hotel Roosevelt, New York City

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